Groundfish Stock Assessments for the West Coast of Canada in 1985 and Recommended Yield Options for 1986

A. V. Tyler, R. P. Foucher and J. Fargo (Editors)

Department of Fisheries and Oceans
Fisheries Research Branch
Pacific Biological Station
Nanaimo, British Columbia V9R 5K6

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by

A. V. Tyler, R. P. Foucher and J. Fargo (Editors)

Department of Fisheries and Oceans
Fisheries Research Branch
Pacific Biological Station
Nanaimo, British Columbia V9R 5K6

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ABSTRACT

Tyler, A. V., R. P. Foucher, and J. Fargo (Eds). 1986. Groundfish stock assessments for the west coast of Canada in 1985 and recommended yield options for 1986. Can. MS Rep. Fish. Aquat. Sci. 1897: 108 p.

Stock assessments and yield options are developed for the Pacific coast of Canada for the following species: lingcod, Pacific cod, Dover sole, rock sole, English sole, sablefish, Pacific hake, spiny dogfish, walleye pollock, Pacific ocean perch, yellowmouth rockfish, rougheye rockfish, silvergrey rockfish, yellowtail rockfish, and canary rockfish. This is an interim report with assessments largely based on mathematical analyses presented in Tyler and McFarlane 1985, and interpreted with 1985 landing statistics. The yield options are recommendations to the fishery managers of the Field Services Division on catch limitations and other fishery management procedures. Biological considerations only, rather than economic factors, are addressed in this document. The yield options are quantitative and are based on a series of appropriate mathematical methods, e.g., virtual population analysis, dynamic pool analysis, and Fournier stock-reconstruction procedures. Alternative options address the possibility of the fishery managers considering high risk and low risk yields in relation to a stock's future potential to produce. Other options, particularly for rockfish and flatfish species, provide a selection of alternatives for managers to consider in regard to whether a stock should be re-built, maintained at status quo, or decreased through non-sustainable catches for present economic emergencies.

Key words: groundfish, stock assessment, fishery yields

RESUME

Tyler, A. V., R. P. Foucher, and J. Fargo (Eds). 1986. Groundfish stock assessments for the west coast of Canada in 1985 and recommended yield options for 1986. Can. MS Rep. Fish. Aquat. Sci. 1897: 108 p.

Les auteurs présentent des évaluations de stock des options de rendement pour les espèces suivantes de la côte canadienne du Pacifique: morue-lingue, morue du Pacifique, sole, sole du Pacifique, sole anglaise, morue charbonnière, merlu du Pacifique, aiguillat commun, lieu de l'Alaska, sébaste à longue mâchoire, sébaste à bouche jaune, sébaste à oeil épineux, sébaste argenté, sébaste à queue jaune et sébaste canari. Les évaluations présentées dans ce rapport intérimaire sont basées en grande partie sur des analyses mathématiques présentées par Tyler et McFarlane en 1985 et interprétées en fonction des statistiques sur les débarquements de 1985. Pour ce qui est des options de rendement, ce sont des recommandations sur les limites des prises et d'autres mesures de gestion des pêches destinées aux gestionnaires des pêches de la Division des services sur le terrain. Les auteurs étudient les aspects biologiques et non les facteurs économiques. Les options de rendement sont quantitatives et basées sur une série de méthodes mathématiques appropriées, c'est-à-dire analyse de population virtuelle, analyse dynamique de groupements et méthodes de remise en état de stock de Fournier. Ces options serviront aux gestionnaires des pêches dans le choix de rendements à risques faibles ou élevés par rapport au potentiel de production future du stock. D'autres options, surtout pour les sébastes et les poissons plats, permettrount aux gestionnaires de décider si un stock doit être remis en état, maintenu à son état actuel ou réduit par des prises non soutenues en cas d'urgence: économiques actuelles.

Mots-clés: poissons démersaux, évaluation de stock, rendements de pêche

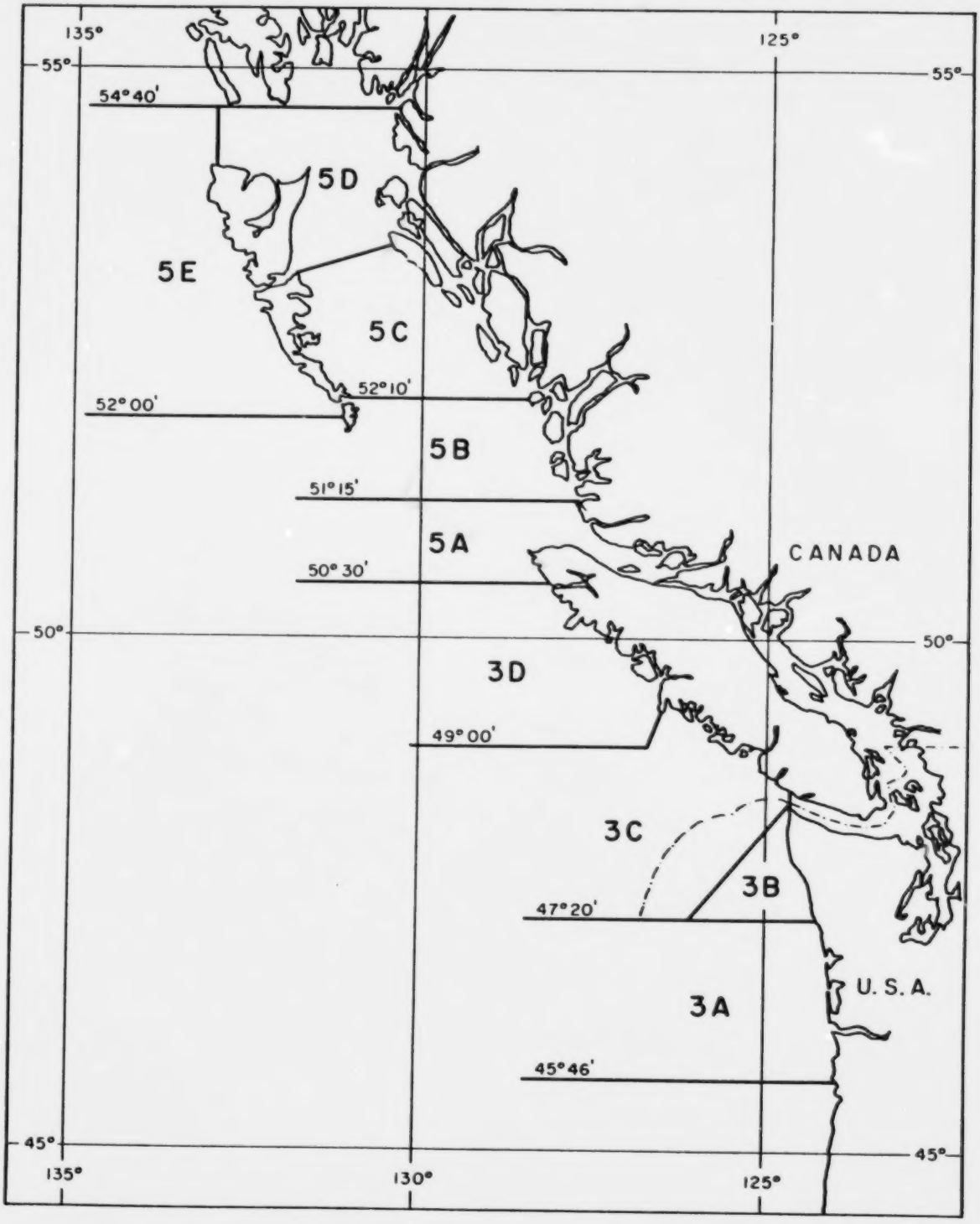

Fig. 1.1. International (Pacific Marine Fisheries Commission) Major Statistical Areas along the British Columbia coast.

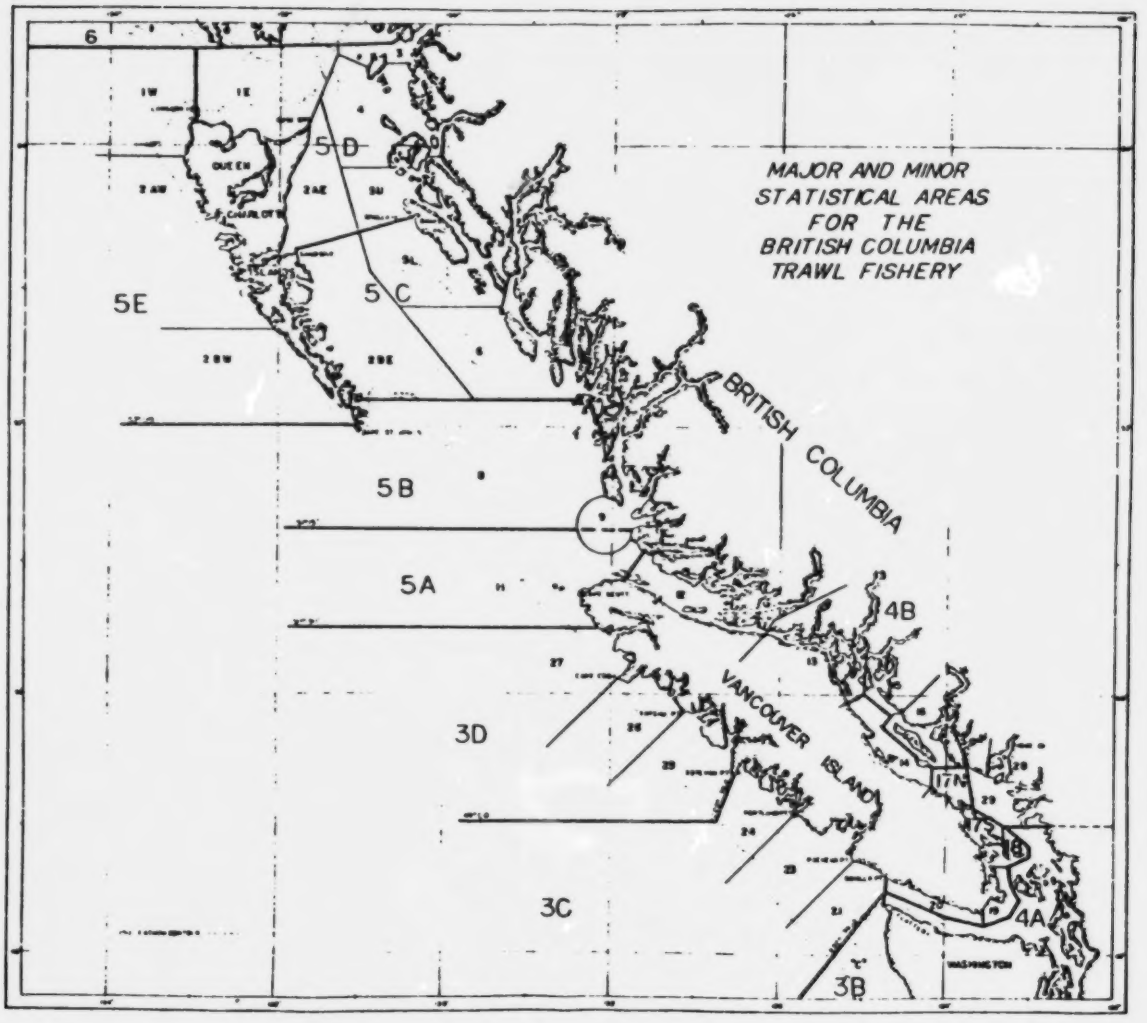

Fig. 1.2. International (Pacific Marine Fisheries Commission) Major and Minor Statistical Areas along the British Columbia coast.

1.0 INTRODUCTION

This report contains biological assessments of the important groundfish stocks, and recommendations for their management to the Offshore Division of the Field Services Branch. The report was prepared by the staff of the Groundfish Section of the Fisheries Research Branch, located at the Pacific Biological Station, Nanaimo, British Columbia, Canada V9R 5K6.

Last year, groundfish research staff carried out an extensive new series of calculations and statistical tests as part of the assessment procedure (Tyler and McFarlane 1985). Such extensive new analyses are carried out only every third year. The purpose of the extensive analysis is to incorporate research findings that are of a more long-term nature. This year is an interim year, and so our report is not so lengthy. The assessments of last year have been updated by one more year. Statistical summary areas are shown in Fig. 1.1, and Fig. 1.2.

2.0 LINGCOD

by A. J. Cass

A comprehensive re-analysis of lingcod has not been conducted since 1984 (Cass 1985). I have, however, summarized our 1984 assessment results (fisheries data to 1983) and reviewed our conclusions and recommendations in view of the performance of the 1984-85 fisheries.

2.1. Coastwide.

Yield options are not proposed on a coastwide basis.

2.2. Strait of Georgia

2.2.1 Condition of stock

The main fisheries are the sports and commercial handline fisheries. We have been unable to estimate the current productivity of stocks due to the lack of a suitable time-series of sport fisheries data. We do believe that stocks are currently lower than historical levels. Lingcod in the Strait of Georgia underwent an intensive period of commercial exploitation beginning in the 1920s. This fishery has all but collapsed since the early 1960s. Landings declined from an average of 1300 t/yr during 1951-62 to an average of less than 400 t/yr during 1973-85. Based on preliminary sales slip data compiled by the Department of Fisheries and Oceans, the 1985 catch is the lowest on record at 102 t. This breaks the 1984 record low of 186 t and is consistent with the long-term decline in handline landings (Table 2.1).

The reason for the decline in stock size is not known, however overfishing is suspected. Although reliable estimates of sports catches were not determined until 1980, it is widely believed that sports fishing in general underwent a rapid expansion in the 1960s, particularly in the Strait of Georgia. We believe sports fishermen began to take a greater share of the catch at that time. The estimated annual catch of lingcod as determined from sports surveys conducted during 1980-84 averaged 110,000 pieces. In 1984, sports landings increased by 73% to 128,000 pieces from 74,000 pieces in 1983 (Table 2.2).

As reported in the 1984 assessment (Cass 1985), tag recapture data and biological samples collected in 1983 indicate that a significant portion of sports landings may consist of immature fish.

In an attempt to rebuild stocks, the winter fishing closure was extended in 1979 (November 15-April 14) to more suitably cover the pre-spawning aggregation, spawning and nesting periods (Low and Beamish 1978; Ketchen 1980; Westrheim 1980; Stocker 1981). Larval and juvenile surveys were conducted during 1981-82 to monitor the effect of the closure on lingcod recruitment (Cass and Scarsbrook 1984). Results of that study and more recent evidence from tagging studies (Cass, unpublished data) indicate that year-class strengths were at above-average levels during 1980-83. However, we cannot assess the impact of the closure on recruitment until we can determine the strength of these and succeeding year-classes in the fishable stock.

2.2.2 Recommendations

Management recommendations for 1986 remain unchanged from 1985. Specifically, we recommend that the present lingcod closure of November 15, 1985 through April 14, 1986 be continued. We also recommend a minimum size limit for sports line-caught lingcod similar to the size limit for the commercial fishery (58 cm). The purpose of this recommendation is to reduce the removal of immature lingcod. This may be particularly relevant in MSA 13 (Fig. 1.2) where declining levels of sport catches and handline LPUE in recent years warrant additional concern for stocks in that area. The nature of the commercial handline fishery, whereby lingcod are routinely kept alive, and results of tagging studies using hook and line capture methods (Cass et al. 1984) indicate lingcod caught by hook and line gear will have a high survival rate if returned to the ocean. The survival rate of discards will ultimately be determined by how much care is taken when removing the hook. We recognize that the practice of persistent fishing and discarding undersized fish until a "keeper" is caught will dampen the benefits of a size limit. However, small lingcod appear to reside in shallower water than larger fish. Therefore sports effort could be re-directed to areas populated by larger lingcod, thereby directly reducing the catch of immature lingcod without a high discard rate.

2.3. West coast Vancouver Island

2.3.1 The Fishery

Lingcod are fished commercially by trawl and, to a lesser extent, handline and troll methods in this area. Commercial concentrations are found mainly off southwest Vancouver Island. For present purposes we have assumed the lingcod resource exists as two separate stocks; one off southwest Vancouver Island (Area 3C-N) and one off northwest Vancouver Island (Area 3D).

2.3.2 Landing Statistics

Standardized landing statistics for the 1956-85 period (Table 2.3) were determined using the Option-2 method of Westrheim (1983) and Westrheim and Foucher (1985). Landings per unit effort (LPUE) were determined from interviewed trawl landings for the May-September fishing season. Trawl landings during this period accounted for 82% of the annual production during 1956-85. LPUE for Area 3C was determined for combined data from the three principal fishing grounds, namely Big Bank, Swiftsure and Minor Statistical Area 24. LPUE for Area 3D was determined for all areas combined. Total effort for each area was calculated by dividing the total all-gear, annual landings by the corresponding LPUE.

Commercial landings off Vancouver Island have undergone marked fluctuations during the 1956-85 period primarily due to variable recruitment. Landings in 1984 continued at higher than average and were 1859 t in Area 3C (Table 2.3) and 474 t in Area 3D (Table 2.4). Trawl landings in 1985 were 3415 t in Area 3C and 380 t in Area 3D. This is consistent with the trend of increased landings since 1980.

Lingcod contribute significantly to commercial fisheries beginning at age 4. They fully recruit over ages 5-7 yr. Based on yield-per-recruit analyses (Cass 1985) there is little to be gained in yield-per-recruit through changes in fishing rates or by increasing the age first fished beyond age 5.

2.3.3 Condition of stock

Estimates of yield were determined in 1984 from Deriso's delay difference model. This model incorporates growth, natural mortality and recruitment to predict biomass and yield. The best fits of the model were obtained by assuming that recruitment was independent of stock size. Results indicate yields at exploitation rates (μ) of 0.5 are sustainable. Estimates of maximum sustainable yields were 1002 t/yr for Area 3C and 440 t/yr for Area 3D. The estimates of MSY assume the production parameters used in the model are free of appreciable error. However, because the estimate of M is not particularly well determined (point estimate) we estimated a lower and upper range of MSY values that we believe includes the true levels of M (0.2 and 0.4). Estimates of MSY for Area 3C at fixed M's of 0.2 and 0.4 were 913 t/yr and 1404 t/yr, respectively. Corresponding estimates of MSY for Area 3D were 458 t/yr and 507 t/yr.

Results from tagging studies off Vancouver Island in 1982 (Cass et al. 1984) indicate exploitation rates during that year were about 0.34. Compared to the estimate of μ (0.5) determined from delay-difference modelling, these results indicated that stocks in Area 3C have been underexploited. However, since 1983, effort and LPUE have been increasing (Table 2.3). Effort has increased to 7832 h in 1985 or by 62% of the 1983 level. LPUE has increased steadily from 234 kg/h in 1983 to 457 kg/h in 1985 or by 95%. In Area 3D, fishing effort declined in 1985 to 62% and 64% of the 1983 and 1984 levels, respectively. LPUE in Area 3D increased in 1985 to 381 kg/h or by 76% of the 1984 level (Table 2.4).

As reported, exploitation rate estimated from the 1982 fishery (μ_1) was 0.34. From the equation:

$$f_1/f_2 = \mu_1/\mu_2,$$

where f_1 and f_2 are estimates of fishing effort from 1982 and 1985, respectively (Ricker 1975). From this relationship estimate of exploitation for (μ_2) 1985 is 0.45. Based on an estimated MSY exploitation rate of 0.5 from Deriso's model, these data indicate exploitation rates in 1985 have approached maximum sustainable levels.

2.3.4 Conclusions

Commercial production appears to be highly dependent on natural fluctuations in recruitment. Major surges in recruitment, such as occurred in the late 1960s and more recently since 1981, appeared as a coast-wide phenomenon in all offshore trawl fisheries. The most recent surge has occurred as a result of strong 1976-78 year-classes. As a result of this recent surge in recruitment, stocks are currently at above-average levels. Preliminary effort data for the 1985 fishery indicate stocks in 1985 are fully utilized.

2.3.5 Recommendations

Estimates of MSY range from 900 t/yr-1404 t/yr for Area 3C and from 450 t/yr-507 t/y for Area 3D. In both 1984 and 1985, landings from Area 3C have exceeded the longterm MSY. The large landings in both years are primarily due to an extremely successful series of year-classes from the late 1970s and early 1980s. There is no evidence that the current rate of fishing is having an adverse effect on stocks off Vancouver Island. However, preliminary effort data for the 1985 fishery indicate stocks in 1985 are almost fully utilized. We are not making any recommendations to alter harvesting strategies off the west coast of Vancouver Island.

Table 2.1. Commercial handline/troll and trawl landings of lingcod (t) from the Strait of Georgia and vicinity (Area 4B), 1951-85.

Year	Handline/ troll[a]	Trawl[b]	Total
1951	1279.5	48.1	1327.6
1952	1488.8	54.0	1542.8
1953	1179.2	28.1	1207.3
1954	1449.4	68.0	1517.4
1955	1220.1	50.6	1270.7
1956	1512.1	55.7	1567.8
1957	1539.7	42.0	1581.7
1958	1445.6	74.6	1520.2
1959	1183.0	336.4	1519.4
1960	1250.6	184.1	1434.7
1961	1157.7	102.1	1259.8
1962	1272.9	75.4	1348.3
1963	989.3	39.6	1028.9
1964	870.4	90.3	960.7
1965	779.7	93.8	873.5
1966	771.3	53.7	825.0
1967	778.6	51.3	829.9
1968	728.1	83.9	812.0
1969	875.7	65.6	941.3
1970	788.6	48.0	836.6
1971	564.0	55.5	619.5
1972	513.4	34.5	547.9
1973	371.8	14.8	386.6
1974	363.7	49.4	413.1
1975	330.5	33.1	363.6
1976	315.5	43.4	358.9
1977	412.5	16.2	428.7
1978	452.6	42.5	495.1
1979	503.7	25.2	528.9
1980	350.5	33.5	384.0
1981	336.0	63.1	399.1
1982	388.2	79.0	467.2
1983	274.8	85.3	360.1
1984	185.7	42.0	224.8
1985	102.0	21.7	123.7

[a]Source: 1951-82. British Columbia Catch Statistics. Department of Fisheries and Oceans, Annual Reports. 1985: preliminary data.

[b]Source: 1951-53. British Columbia Catch Statistics, Department of Fisheries and Oceans, Annual Reports. 1954-84: PBS computer files.

Table 2.2. Number of lingcod landed (thousands) in the sport-line fishery in the Strait of Georgia by Minor Statistical Area, 1980-84.[a]

	Minor Area									
Year	13	14	15	16	17	18	19	28	29	Total
1980	44.3	14.1	2.5	21.8	19.3	8.8	15.6	4.2	6.1	136.7
1981	31.9	14.7	6.8	10.0	10.1	11.6	25.3	5.8	8.6	124.8
1982	16.0	6.1	1.6	20.1	9.6	7.5	12.6	6.4	5.4	85.3
1983[b]	16.2	2.3	1.1	20.1	7.0	6.2	9.9	6.7	4.3	73.8
1984[b]	36.4	11.4	1.7	28.5	16.2	6.8	10.7	8.0	8.1	127.8

[a]Landings were estimated from results of the Strait of Georgia creel survey.

[b]1984 estimates are preliminary.

Table 2.3. Lingcod landing statistics for Area 3C, 1956-85.

Year	Landed catch			LPUE (kg/h)	Effort (h)
	Trawl (t)	Line (t)	Total (t)		
1956	1151	67	1218	263	4640
1957	1070	123	1193	226	5275
1958	1047	56	1103	286	3855
1959	1742	67	1809	274	6600
1960	1867	94	1961	251	7809
1961	1972	51	2023	288	7025
1962	890	66	956	141	6756
1963	609	58	667	198	3366
1964	1127	42	1169	397	2945
1965	1812	55	1867	302	6188
1966	2030	80	2110	332	6355
1967	1779	119	1898	446	4259
1968	1661	76	1737	566	3071
1969	1054	88	1142	267	4280
1970	703	132	835	271	3077
1971	979	127	1106	200	5538
1972	625	141	766	96	8009
1973	876	84	960	258	3724
1974	1029	93	1122	209	5367
1975	1630	86	1716	247	6933
1976	1205	118	1323	132	10052
1977	844	136	980	121	8112
1978	360	92	452	97	4668
1979	602	86	688	160	4287
1980	623	97	720	155	4644
1981	603	240	843	144	5840
1982	1510	220	1730	295	5856
1983	970	167	1137	234	4858
1984	1731	128	1859	371	4987
1985[a]	3415	164	3579	457	7832

[a]Line landings are preliminary.

Table 2.4. Lingcod landing statistics for Area 3D, 1956-85.

Year	Landed catch			LPUE (kg/h)	Effort (h)
	Trawl (t)	Line (t)	Total (t)		
1956	164	124	288	316	913
1957	130	135	264	392	674
1958	110	120	230	211	1088
1959	64	93	157	529	297
1960	87	106	193	660	292
1961	200	115	315	400	786
1962	286	103	389	199	1959
1963	115	121	237	277	855
1964	226	85	310	391	794
1965	505	90	595	315	1886
1966	585	135	720	427	1686
1967	460	166	225	434	1442
1968	868	107	975	604	1616
1969	619	77	696	293	2371
1970	456	157	613	268	2285
1971	264	114	378	174	2173
1972	85	181	266	197	1346
1973	172	84	256	364	705
1974	242	113	356	559	634
1975	347	90	437	252	1733
1976	245	90	336	280	1199
1977	158	107	265	232	1141
1978	197	94	291	467	623
1979	105	76	180	178	1013
1980	86	70	156	87	1794
1981	75	108	183	206	887
1982	49	232	281	115	2430
1983	446	119	565	254	2220
1984	153	321	474	217	2184
1985[a]	380	152	532	381	1396

[a]Line landings are preliminary.

2.4. Queen Charlotte Sound

2.4.1. The Fishery

Lingcod have been an important component of shelf-groundfish fisheries in Queen Charlotte Sound since 1955. Commercially exploited stocks are located on the Cape Scott and Goose Island grounds. However, stock delineation is poorly understood. For present purposes we have assumed that lingcod off Cape Scott (Area 5A) and on the Goose Island grounds (Area 5B) are two separate stocks.

2.4.2. Landing Statistics

Landings per unit effort (LPUE) for the 1956-85 period were determined from interviewed trawl data for the May-September fishing period using Westrheim's (1983) Option-2 method. Effort was standardized for variations in vessel horsepower class according to Westrheim and Foucher (1985). Total annual effort was estimated by dividing LPUE into the corresponding total all-gear landings.

Landings from Queen Charlotte Sound peaked at 2300 t in 1968 and again in 1983 at 1400 t. Landings in 1984 declined to 790 t; 302 t in Area 5A (Table 2.4.1) and 486 t in Area 5B (Table 2.4.2). Fishing effort declined by 5% and 15% in 1984 in Areas 5A and 5B, respectively. LPUE declined by 45% in Area 5A and 28% in Area 5B.

In 1985, landings increased to 898 t; 422 t in Area 5A and 476 t in Area 5B. The decline in fishing effort observed in 1984 continued in 1985 in Area 5B (Table 2.4.2). Effort in Area 5A has remained near 1984 levels (Table 2.4.1). LPUE has increased from 1984 levels in both Areas 5A and 5B in keeping with the trend for higher than average levels of LPUE since 1980.

2.4.3. Recommendations

As presented in Cass (1985) our estimates of MSY were 450 t/yr in Area 5A and ranged from 639-733 t/yr in Area 5B.

Stocks in Queen Charlotte Sound appear to be in good shape. Landings in 1984 and 1985 have remained below our estimate of MSY. At present there is no evidence to indicate the dynamics of lingcod stocks in Queen Charlotte Sound are adversely influenced by fishing pressure. Therefore, we are not making any recommendations for Queen Charlotte Sound stocks.

2.5. Hecate Strait

Yield options are not proposed for this region.

2.6. West coast of Queen Charlotte Islands

Yield options are not proposed for this region.

Table 2.5. Lingcod landing statistics for Area 5A, 1956-85.

Year	Landed catch			LPUE (kg/h)	Effort (h)
	Trawl (t)	Line (t)	Total (t)		
1956	350	0.0	350	52	6792
1957	433	0.1	433	150	2896
1958	296	0.0	296	23	12883
1959	192	0.1	192	73	2648
1960	280	0.1	280	62	4521
1961	388	1	389	233	1669
1962	531	9	540	152	3548
1963	285	5	290	122	2380
1964	352	0.3	352	227	1555
1965	331	0.1	331	176	1886
1966	707	7	714	173	4118
1967	759	1	760	168	4510
1968	1227	1	1228	251	4889
1969	617	1	618	90	6853
1970	590	5	595	133	4475
1971	230	5	235	83	2829
1972	164	11	175	90	1946
1973	232	11	243	192	1261
1974	339	16	355	178	1993
1975	82	14	96	65	1481
1976	258	11	269	48	5619
1977	122	14	136	34	3997
1978	128	6	134	39	3465
1979	100	8	108	44	2435
1980	108	6	114	35	3262
1981	183	25	208	96	2167
1982	467	25	492	150	3282
1983	573	28	601	244	2462
1984	257	45	302	133	2270
1985a	407	15	422	185	2281

[a]Line landings are preliminary.

Table 2.6. Lingcod landing statistics for Area 5B, 1956-85.

Year	Landed catch			LPUE (kg/h)	Effort (h)
	Trawl (t)	Line (t)	Total (t)		
1956	250	3	253	78	3222
1957	170	2	172	118	1450
1958	277	1	278	119	2336
1959	429	1	430	203	2115
1960	378	12	390	127	3066
1961	323	31	354	113	3127
1962	407	28	435	146	2987
1963	357	25	382	155	2459
1964	335	7	342	122	2813
1965	566	9	575	150	3824
1966	827	20	847	211	4006
1967	901	24	925	247	3742
1968	1043	20	1063	275	3867
1969	517	12	529	86	6176
1970	390	32	422	55	7630
1971	415	11	426	72	5911
1972	476	36	512	47	10965
1973	349	11	360	29	12548
1974	532	19	551	683	6636
1975	429	22	451	47	9563
1976	346	30	376	48	7818
1977	257	12	269	59	4531
1978	162	10	172	42	4132
1979	242	11	253	48	5286
1980	300	10	310	46	6763
1981	548	24	572	153	3744
1982	579	29	608	190	3193
1983	772	26	798	255	3122
1984	455	31	486	183	2656
1985[a]	462	7	423	256	1652

[a]Line landings are preliminary.

3.0. PACIFIC COD — A. V. Tyler, S. J. Westrheim, R. P. Foucher

3.1. Coastwide

Yield options are not proposed on a coastwide basis.

3.2. Georgia Strait and vicinity

A new assessment was not carried out this year, and yield options are not proposed.

3.3. West Coast of Vancouver Island

3.3.1. Condition of stock

Abundance of Pacific cod (Gadus macrocephalus) in this area continues to be very low based on the abundance index previously developed (Westrheim and Foucher, in press, and 1985). The low-abundance condition has persisted since 1981 (Table 3.1). The abundance index for Pacific cod landed from grounds off west Vancouver Island is the standardized LPUE (kg/h) for Quarters II + III on Big Bank. Abundance index for the WCVI is lower than for any other year in its 30-year history. The previous low occurred in 1961-62.

3.3.2. Recommendation

Since the abundance of Pacific cod remains at a very low level, we must recommend that Amphitrite Bank (and a safe margin around it) be closed to all trawling during January-March 1986. The closure is to protect spawning cod, since they are particularly vulnerable to trawling in the Amphitrite Bank region. Based on evidence presented last year, we believe that a fishery at this time could remove enough spawning fish to interfere with stock recovery.

3.4. Queen Charlotte Sound

A new assessment of the cod stock in this area has not been carried out because last year's assessment showed that there was little danger of over-fishing, though the stock abundance was low. The stock is provided with a refuge in areas where the bottom is currently considered to be untrawlable.

Table 3.1. Pacific cod landings and landings per unit effort (LPUE) from the West Coast of Vancouver Island and Hecate Strait, April-March, 1956-1985.

	Areas 3C + 3D		Areas 5C + 5D	
	LPUE (kg/h)	Landings (t)	LPUE (kg/h)	Landings (t)
Year	Qtrs. 2, 3	Total	Qtrs. 2, 3[a]	Total
1956-57	123	1485	1031	2016
1957-58	108	1674	808	3251
1958-59	84	798	1400	5701
1959-60	36	926	1205	3517
1960-61	52	565	659	2390
1961-62	17	518	699	1521
1962-63	34	827	770	2056
1963-64	93	1167	952	2658
1964-65	284	1991	1646	6324
1965-66	199	2678	1626	8927
1966-67	210	3230	1424	8996
1967-68	73	1810	1112	6115
1968-69	77	1069	364	3927
1969-70	60	936	327	2576
1970-71	133	1581	226	1182
1971-72	474	4903	240	1307
1972-73	483	5681	689	2899
1973-74	191	3038	1143	3822
1974-75	194	3879	1064	5247
1975-76	157	3502	595	5410
1976-77	180	3424	474	4168
1977-78	149	2512	358	3462
1978-79	168	1392	342	2298
1979-80	223	1568	476	5500
1980-81	125	1163	369	4227
1981-82	61	1519	204	2642
1982-83	36	608	421	2507
1983-84	66	838	450	2292
1984-85	32	507	328	1718
1985-86	13	439	149	1051[b]

[a]Calculated by combining April-September LPUEs for 5C and 5D each weighted by landings from appropriate major area.

[b]Landings for 1985-86 as of June 30, 1986.

3.5. Hecate Strait

3.5.1. Condition of stock

The stock abundance in Hecate Strait continues to be low as indicated by the abundance index developed last year (Westrheim and Foucher in press, and 1985). The stock has been in very low abundance since 1977 (Table 3.1). Statistical studies of biological and physical factors influencing year-class strength were carried out during the summer of 1985. Factors which tend to increase year-class strength include a high abundance of herring (presumably as feed) and water temperatures during the spawning period (February) in the range from 6.5° to 7.5°. Factors which tend to decrease year-class strength include lack of feed, adverse temperatures, and a strong northward current during the spawning period. Such currents occur when there is persistent and strong wind from the south during winter (Tyler and Westrheim, in press; Walters, Stocker, Tyler and Westrheim 1986). Conditions have changed from generally adverse to favourable over the last year compared to the previous seven years, and allow the possibility that a good year-class might be developing from the 1985 spawning.

3.5.1. Recommendations

Conservative sustainable yield-option: 900 t catch limit.
Sustainable yield-option: 1800 t catch limit.
Risk yield-option: No quota, fishing effort self-regulating.

Our recommendations this year are the same as last year. The sustainable yield option is based on the observation that during the previous periods when abundance was as low as at present, (60-63, and 69-72), landings averaging 1800 t did not interfere with the recovery of the stock. The risk option was formulated on the basis that fishing effort has in the past been tied to the abundance of cod, so that less cod meant less effort and proportionately lower catch. The managers selected the risk option last year. The resulting catch in the 1984-85 cod year turned out to be 1718 t, indicating that self-regulation occurred without a closure.

4. FLATFISH

By J. Fargo

4.1. Coastwide

Yield options are not proposed for flatfish species on a coastwide basis.

4.2. Strait of Georgia

Yield options are not proposed for flatfish species for this region.

4.3. West Coast of Vancouver Island

No new assessments have been carried out for flatfish species in this region and yield options remain the same as those in 1984 (Fargo 1985).

4.4. Queen Charlotte Sound

4.4.1. Rock sole

Ketchen (1982) in summarizing results of tagging experiments on Goose Island ground from 1952-54, noted several instances of tags recovered on Cape Scott. He also suggested a possible route for movement of rock sole from Goose Island to Cape Scott. The decline in abundance for Goose Island rock sole as indicated in the Area 5B LPUE time series (1966-73) could be accounted for by emigration of rock sole from Goose Island to Cape Scott. A new set of landing statistics for rock sole in the Queen Charlotte Sound region is considered in this assessment.

4.4.1.1. Area 5A rock sole condition of stock

Standardized landing statistics (Foucher 1984) are presented in Table 4.1, updated with 1984-85 fishery observations. In 1984 LPUE rose significantly while effort and landings declined. In 1985 landings, effort and LPUE all declined. Effort declined most notably in 1985, to half the effort level in 1984. The effort time series shows no trend and little contrast throughout. The average yield from 1979-85 was approximately 200 t.

4.4.1.2. Recommendations:

Sustainable yield option:	A yield of 200 t has been sustainable over the last six years.
Non-sustainable yield options:	Yields of 500 tons may be sustainable only for periods of high recruitment. This estimate is based on the highest historical yield from the fishery, during a period of high recruitment.

4.4.1.3. Area 5B rock sole condition of stock

Standardized landing statistics (Foucher 1984) are presented in Table 4.2. Fishery observations from 1984-85 are included. In 1984 landings, effort and LPUE all declined from 1983 levels, while in 1985 LPUE rose to the highest level since 1980, while effort declined from 1984.

The significant decline in LPUE of rock sole from 1966-1973 is not accompanied by a significant increase in fishing effort. Without ageing summaries for the period it is not possible to examine changes in age structure for the population from 1966-73 to see whether progressively younger fish have been landed, indicating fishing-up.

4.4.1.4. Recommendations

Sustainable yield option: For recent years (1973-85), excluding the anomalous year of 1980, an average sustainable yield of 200 t has been calculated. The observation in 1980 indicates that a 400 t yield may be sustainable. The LPUE time series has not been affected by the increase in landings of rock sole in 1980, presumably indicating a steady stock size.

4.4.1.5. Queen Charlotte Sound rock sole condition of stock

A set of landing statistics has been compiled for the Queen Charlotte Sound region (Table 4.3). The reason for doing this has been outlined in Section 4.4.1. I will estimate the yield for rock sole from the Queen Charlotte Sound region and compare this estimate and time series of landing statistics to the time series for Area 5A and 5B.

The landing statistics for Queen Charlotte Sound region were derived in the following manner:

1) landings for QCS are the sum of landings from 5A and 5B.

2) LPUE for QCS is equal to the mean of the LPUEs for 5A and 5B weighted by their respective landings.

3) Total QCS effort was calculated from QCS landings and QCS LPUE.

The correlation coefficients for the QCS LPUE time series vs the individual LPUE time series for 5A and 5B were 0.88 and 0.96, respectively.

4.4.1.6. Recommendations

Sustainable yield option: Since 1978, effort levels have remained fairly constant and near the long-term average for the 1956-84 period. An average sustainable yield of 400 t has been calculated for rock sole for the Queen Charlotte Sound region, based on landings from 1979-84. This is equivalent to the sum of the individual sustainable yield options for 5A, 5B, given above.

At the present time results of the above analysis indicate no difference in estimates of sustainable yield for rock sole in Queen Charlotte Sound, whether considered as the entire region or separate areas (5A, 5B). I

suggest, however, that until ageing results or length frequencies for rock sole from both areas can be compared to ascertain if similarities exist, rock sole in Area 5A and Area 5B should be treated as separate stocks.

4.5. Hecate Strait

4.5.1. Rock sole

4.5.1.1. General

Complete stock assessments for rock sole in Areas 5C and 5D for 1956-83 are presented in Fargo 1985, using a wide variety of analyses.

The following stock assessments deal only with updated catch-effort statistics and recruitment indices from trawl surveys for juvenile flatfish.

4.5.1.2. Rock sole Area 5C.

4.5.1.3. Landing statistics

LPUE for rock sole in Area 5C rose significantly in 1984 from 1983, while effort expended in 1984 was only 32% of effort expended in 1983. Effort expended in 1985 was about the same as in 1984 while LPUE dropped significantly (Table 4.4). Current effort levels for rock sole in Area 5C are only 15% of the historical average (1955-83). The current fishing mortality level for the rock sole stock in Area 5C is therefore deemed to be very low at the present time.

4.5.1.4. Condition of stock

Recruitment indices for rock sole are derived from L-F anomalies (Fargo 1985) in the absence of ageing data.

In 1984 an analysis was done to determine the number of samples needed for 1) catch-at-age analysis for the species and 2) calculation of length frequency anomalies. A minimum of 3 samples annually is needed for rock sole in Area 5C to detect changes in recruitment using length frequency anomalies. In 1984, only 1 sample was collected for rock sole in Area 5C and a L-F anomaly for 1984 was not calculated.

Abundance indices for pre-recruit rock sole calculated from juvenile trawl survey catch rates from 1980-85 indicate that the rock sole recruitment in Hecate Strait is currently at low levels and declining.

4.5.1.5. Recommendations

Sustainable yield option: With the current low recruitment mode the 30,000 lb landing limit should be retained.

4.5.1.6. Area 5D rock sole.

4.5.1.7. Landing statistics

In 1984-85, LPUE for Area 5D rock sole declined to its lowest level, while effort levels rose (Table 4.5). LPUE peaks in the 1950s and 1960s are associated with periods of high recruitment in cohort analysis results. LPUE for the species declined significantly in the late 1960s and early 1970s with no increase in fishing effort. The cause for this overall decline in abundance is not known. However, fishing effort levels in the late 1970s may have had the effect of holding the population at low levels of abundance. The LPUE index for rock sole is also correlated significantly with fishing effort directed at Pacific cod in Hecate Strait (r^2 = .50 effort data from Westrheim and Foucher 1985).

4.5.1.8. Condition of stock

Recruitment indices as calculated L-F anomalies from port samples were not calculated for Area 5D in 1984 due to lack of adequate number of samples (Sec. 4.5.1.4).

Recruitment indices for rock sole in Hecate Strait calculated from juvenile trawl survey data (1980-85), indicate a low recruitment mode for rock sole. No significant increase in rock sole recruitment is predicted through the end of the 1980s because of high sea temperatures on the spawning grounds in March from 1979-84 (Fargo 1985).

Rock sole in Area 5D are at low levels of abundance, based on results from LPUE and cohort analysis (Fargo 1985). In the 1980s, abundance and recruitment levels have continued to decline in spite of the current trip limit regulation. Production levels for the stock suggested by previous surplus production analyses (Stocker 1981) have not been exceeded in any of the last 5 years, but the LPUE time series shows a progressive decline over that period. English sole in Area 5D with the same mortality rate estimates and age structure as rock sole show no sign of such a decline. The decline in rock sole abundance in Area 5D appears to be due in part to natural causes associated with recruitment. Along with the low recruitment rates, the current fishery may prevent the stock from increasing in size. The relationship between rock sole recruitment and stock size and sea surface temperature is described in Fargo (1985). The relationship indicates that temperature and low parent stock-size are both sub-optimal for recruitment. At present, the rock sole population in Area 5D as indicated by LPUE, is probably at or below the level needed to produce strong year-classes under optimum temperature conditions.

4.5.1.9. Recommendations

Rebuilding yield option: with effort levels as low as those observed in 1984 and 1985, a closure of Area 5D (no yield) is the only option available to effect a decrease in fishing effort for rock sole. This is not recommended for the following reasons: 1) The general decline in abundance for rock sole in Area 5D appears to be due in significant part to natural causes. 2) Fisheries for English sole, Dover sole and Pacific cod in Area 5D contribute to the major production for the region, and this production would cease under an area closure.

Sustainable yield option: The current sustainable yield for rock sole in Area 5D is calculated at 200 t. This is an average of the yields for the period 1981-1983 where LPUE was fairly stable and recruitment was similar. The 30,000 lb trip limit in effect for rock sole in Area 5D will achieve this option.

4.5.2. English sole

4.5.2.1. General

Detailed stock assessments for English sole utilizing results of LPUE and catch-at-age analysis are presented in Fargo (1985). Catch-effort time series from that document are updated for 1984-85 observations. Length frequencies from port samples in 1984 are also used in this assessment. No new ageing data are available since the last analysis.

4.5.2.2. Landing statistics

The low LPUE from 1976-80 (Table 4.6) was probably due to a significant increase in the number of vessels fishing during the period. With a significant drop in effort levels, LPUEs in 1984 and 1985 are near the long-term average (1956-85), indicating no significant decline in abundance of English sole due to the high effort levels of 1976-80.

4.5.2.3. Condition of stock

The 1984 length frequency anomaly for female English sole indicates a slight increase in recruitment to the 1984 fishery. Abundance indices from the juvenile trawl survey indicate an upward trend in abundance of 1-year-old English sole in 1984 and 1985. These fish will not be commercial size until 1988-89 however, but a general increasing trend for recruitment is implied.

Recent yield simulations (Fargo 1985) have indicated that the greatest gain in production for English sole would come from raising the age first fished (controlling discards) rather than controlling fishing effort. Yield simulation estimates of the long-term gain in annual English sole production through elimination of discards is approx. 30%. This figure was confirmed in a study of discards on several species, including English sole, in Hecate Strait (Stanley 1985). The two major assumptions here are 1) that discarded juvenile English sole die; 2) the natural mortality rate of English sole is approx. 0.2.

An analysis has been completed to determine what increases in English sole production could be achieved through time-area closures to protect large, pre-recruit age-classes of English sole. Results of this analysis indicate that, at the present time, no increase in English sole production could be achieved through time-area closures, given the current size of English sole pre-recruit age-classes.

4.5.2.4. Recommendations

Sustainable yield option. The average sustainable yield for English sole over the last 5 years of the fishery has been approximately 650 t. This amount could increase if recruitment to the fishery increases in 1986. A

catch limitation is not recommended under the present levels of fishing effort.

Increased production yield option. Increases in production due to partial elimination of discards by time area closures in 5D would not be significant at this time because the size of pre-recruit age groups is determined to be about the same as that of age groups in the fishery. A significant increase in production could be achieved through selling/marketing more English sole males. The minimum legal size for English sole is 30 cm while the size sorted for fish plants is approx. 35 cm. The 35 cm minimum size precludes the harvest of most mature males.

4.5.3. Dover sole 5C,D,E

4.5.3.1. General

Detailed stock assessments for Dover sole in Areas 5C,D,E are contained in Fargo (1985).

LPUE was standardized using a log linear least squares model (Gavaris 1980; Kimura 1980). Independent variables included horsepower class, month and year. The inclusion of horsepower class represents an attempt to account for the variation among years in the proportion of effort contributed by the larger, more efficient vessels. Although each independent variable was significant in F tests ($P = 0.1$), together they accounted for only 27% of the variation in Dover sole LPUE. It was not possible to account for a "learning effect" because the necessary information for that analysis is lacking.

Recent results from analysis of tag recoveries and fishery data indicate that, during the summer months, the catches at Dundas are more representative of the Dover sole population than catches from Two Peaks, Butterworth, which involve a mixed species fishery. Accordingly, the data set for standardization in this report involved Dover sole landings from Dundas only at 3 different qualification levels 0%, 25%, 50% (Fig. 4.5.4). A qualification level of 50% means that a vessel trip catch is included in the calculations only if it contains quantities of Dover sole greater or equal to 50% of the weight of all species landed for the vessel trip.

4.5.3.2. Landing statistics

Landing statistics for Dover sole for 1970-85 are presented in Table 4.7. The best fit to the model was with the 50% qualified data set. LPUE exhibits a downward trend from 1970-1977 after initial exploitation and an upward trend from 1978-84. With the removal of 900 t in 1984, LPUE declined. This is consistent with the concept that removals greater than MSY levels will result in a decrease in abundance (LPUE). In 1985, LPUE rose slightly from 1984, with landings at MSY level.

The estimate for MSY using Gulland's (1961) production analysis is 825 t for the Dover sole 5C,D,E stock.

4.5.3.3. Condition of stock

The tag recovery analysis estimate of total mortality rate (Z) for

the stock is 0.30. Estimates of the instantaneous rate of natural mortality (M) for Dover sole in U.S. waters vary from 0.15-0.20. Taking the lower value for M and calculating F, where Z = F + M, yields an estimate of 0.15 for F. This corresponds to an exploitation rate of 0.13. The implication here is that the stock is currently being fully utilized, but is not over-exploited.

4.5.3.4. Recommendations

Rebuilding yield option. Not required.

Sustainable yield option. 800 t--equivalent to the MSY for the Gulland analysis.

Table 4.1. Standardized Canada-U.S. landing statistics for rock sole from Area 5A, January-December 1956-85.

Year	Landings (t)	Effort (h)[a]	LPUE (kg/h)[b]
1956	551	1328	415
1957	511	1780	287
1958	501	1920	261
1959	212	1293	164
1960	397	1640	242
1961	237	1139	208
1962	196	1719	114
1963	161	1288	125
1964	156	1642	95
1965	157	1040	151
1966	330	1803	183
1967	252	1292	195
1968	435	2042	213
1969	293	2203	133
1970	167	1144	146
1971	135	1000	135
1972	58	763	76
1973	57	722	79
1974	74	1451	51
1975	37	597	62
1976	182	3309	55
1977	83	1766	47
1978	79	1129	70
1979	202	1474	137
1980	238	1384	172
1981	114	726	157
1982	189	1512	125
1983	124	1824	68
1984	142	1214	117
1985	53	639	83

[a]Effort = (Landings)(1000)/LPUE.

[b]LPUE -- Area 5A, April-September.

Table 4.2. Standardized Canada-U.S. landing statistics for rock sole from Area 5B January-December 1956-85.

Year	Landings (t)	Effort (h)[a]	LPUE (kg/h)[b]
1956	307	853	360
1957	206	619	333
1958	379	1606	236
1959	344	1339	257
1960	503	1863	270
1961	416	1770	235
1962	531	2091	254
1963	517	1958	264
1964	482	2472	195
1965	568	2021	281
1966	772	2339	330
1967	741	2487	298
1968	392	1774	221
1969	652	2751	237
1970	245	1161	211
1971	368	2079	177
1972	382	2748	139
1973	324	5586	58
1974	371	7275	51
1975	408	4250	96
1976	368	4182	88
1977	188	3133	60
1978	217	2932	74
1979	208	2667	78
1980	410	1925	213
1981	220	2588	85
1982	155	3039	51
1983	206	2424	85
1984	87	2071	42
1985	159	1622	98

[a]Effort = (Landings)(1000)/LPUE.
[b]LPUE -- Area 5B, April-Sept.

Table 4.3. Standardized Canada-U.S. landing statistics for rock sole, from Queen Charlotte Sound January-December 1956-85.

Year	Landings (t)[a]	Effort (h)[b]	LPUE (kg/h)[c]
1956	856	2178	394
1957	717	2398	299
1958	880	3520	250
1959	556	2471	225
1960	900	3488	258
1961	653	2915	224
1962	727	3429	212
1963	678	3013	225
1964	638	4197	152
1965	725	2984	243
1966	1102	4206	262
1967	993	4103	242
1968	827	3847	215
1969	945	5136	184
1970	412	2424	170
1971	503	3144	160
1972	440	3548	124
1973	381	5773	66
1974	445	8725	51
1975	445	4837	92
1976	550	7237	76
1977	271	4839	56
1978	296	4055	73
1979	410	3832	107
1980	648	3273	198
1981	334	3036	110
1982	330	3474	95
1983	344	4354	79
1984	229	2573	89
1985	212	2280	93

[a]Landings = landings 5A + landings 5B.

[b]Effort = landings/LPUE x 1000.

[c]LPUE = Mean of 5A & 5B LPUEs (April-September) weighted by April-September landings.

Table 4.4. Standardized Canada-U.S. landing statistics for rock sole from Area 5C, January-December 1956-85.

Year	Landings (t)	Effort (h)[a]	LPUE (kg/h)[b]
1956	397	570	699
1957	726	1396	520
1958	368	944	390
1959	249	1078	231
1960	471	1186	397
1961	110	350	314
1962	322	651	495
1963	155	451	344
1964	244	1179	207
1965	539	4115	131
1966	961	2921	329
1967	948	1992	476
1968	811	1940	419
1969	1053	4066	259
1970	694	2410	288
1971	376	1301	289
1972	134	388	345
1973	186	565	329
1974	288	1269	227
1975	383	2176	176
1976	277	1689	164
1977	272	1470	185
1978	356	1240	287
1979	647	2451	264
1980	482	2634	183
1981	126	2377	53
1982	70	1842	38
1983	60	1132	53
1984	64	362	177
1985	27	342	79

[a]Effort = (Landings)(1000)/LPUE

[b]LPUE -- April-September

Table 4.5. Standardized Canada-U.S. landing statistics for rock sole from Area 5D, January-December 1956-85.

Year	Landings (t)	Effort (h)[a]	LPUE (kg/h)[b]
1956	763	1538	496
1957	425	2361	180
1958	888	742	1197
1959	167	1099	152
1960	656	989	663
1961	634	402	1578
1962	507	754	672
1963	726	1287	564
1964	499	1102	453
1965	340	1255	271
1966	1583	3244	488
1967	1214	918	1323
1968	1555	3337	466
1969	1356	2122	639
1970	709	1672	424
1971	1127	2466	457
1972	381	2268	168
1973	321	2568	125
1974	334	2212	151
1975	821	5864	140
1976	1161	5609	207
1977	574	8085	71
1978	518	3453	150
1979	666	11288	59
1980	495	7174	69
1981	458	8035	57
1982	221	3508	63
1983	187	2922	64
1984	124	5905	21
1985	70	7000	10

[a]Effort = (Landings)(1000)/LPUE.

[b]LPUE -- Two Peaks-Butterworth, April-September.

Table 4.6. Standardized Canada-U.S. landing statistics for English sole, Area 5D, January-December 1956-85.

Year	Landings (t)	Effort (h)[a]	LPUE (kg/h)[b]
1956	935	1300	719
1957	539	1653	326
1958	674	2332	289
1959	901	2468	365
1960	1079	1505	717
1961	865	1676	516
1962	436	1232	354
1963	369	3101	119
1964	420	2308	182
1965	391	3491	112
1966	329	5141	64
1967	511	2077	246
1968	632	3144	201
1969	725	2571	282
1970	920	2402	383
1971	482	2708	178
1972	356	2211	161
1973	598	2265	264
1974	459	2318	198
1975	922	3415	270
1976	946	6757	140
1977	972	7594	128
1978	495	4714	105
1979	744	8651	86
1980	796	7044	113
1981	1148	7705	149
1982	401	3457	116
1983	396	2829	140
1984	606	3367	180
1985	547	2681	204

[a]Effort = (landings)(1000)/LPUE.

[b]LPUE -- Two Peaks-Butterworth, April-September.

Table 4.7. Standardized Canada-U.S. landing statistics for Dover sole, Areas 5C, D, E, 1970-85.

Year	Landings (t)[a]	Effort (h)[b]	LPUE (t/h)[c]
1970	965	1413	0.683
1971	903	1364	0.662
1972	922	1478	0.624
1973	768	961	0.799
1974	767	916	0.837
1975	882	1370	0.644
1976	1022	2349	0.435
1977	577	1826	0.316
1978	483	1121	0.431
1979	697	2723	0.256
1980	807	2431	0.332
1981	840	1791	0.469
1982	512	1347	0.380
1983	693	1227	0.565
1984	953	2015	0.473
1985	828	1687	0.491

[a] 0% qualified Canadian landings, 5C, D, E.

[b] Effort (h) = landings (t)/LPUE (t/h).

[c] LPUE = 50% qualified landings -- Dundas standardized by log linear model.

5.0 SABLEFISH

by M. Saunders

5.1. Coastwide

5.1.2. The fishery

In 1985 a total of 4189 t of sablefish were landed coastwide by trap, trawl, and longline. Landings from the west coast of Queen Charlotte Islands and Hecate Strait decreased from 2300.9 t in 1984 to 2298.1 in 1985 with the majority (81.1%) caught by trap (Table 5.1). Landings from the west coast of Vancouver Island increased to 1890.5 t in 1985 from 1520.1 t in 1984. The majority of fish were trap-caught (86.6%), up considerably from 78.2% in 1984 (Table 5.2). Trawl landings decreased from 120.0 t in 1984 to 93.9 t in 1985 from the west coast of Vancouver Island and increased from 64.8 t in 1984 to 135.1 t in 1985 from all other areas (Table 5.1, 5.2).

5.1.3. Landing statistics

In 1985 trap landings were evenly split between the three areas with fewer fish landed from areas adjacent to the Queen Charlotte Islands and in Queen Charlotte Sound, and more landed from the west coast of Vancouver Island compared with 1984; (Table 5.3).

The coastwide LPUE from 1979 to 1985 has varied from 13.0 to 17.3 kg/trap (Table 5.4) in 1984 and 1975 respectively. The coastwide decline in LPUE noted between 1984 and 1985 occurred in all three areas with increases of 30%, 36%, and 54% in areas adjacent to Vancouver Island, in Queen Charlotte Sound and adjacent to the Queen Charlotte Islands, respectively (Table 5.3).

5.1.4. Condition of stock

There is no change in stock assessment from McFarlane et al. (1985). Effort standardization (multivariate) is presently being completed. When 1984 and 1985 ages become available, further age-structured analysis will be carried out. No changes in 1983 and 1984 length-frequency distributions and the 1983 age frequency distribution have occurred.

5.1.5. Recommendations

The recommended yield option at the conservative level for 1986 is unchanged from 1985 (McFarlane et al. 1985) at 4000 t. A high risk level could be as much as 5000 t. Until standardization of effort is completed and the decrease noted in 1984 LPUE evaluated, and further age-structured analysis is complete, there is a strong possibility that the high risk option will interfere with future yield for the fishery.

Table 5.1. Canadian sablefish landings, by gear, from Queen Charlotte Sound, Hecate Strait, and the west coast of Queen Charlotte Islands, 1973-1985 (round wt, metric tonnes)[a], excluding dumped and discarded fish.

	Gear type								
	Longline		Trawl		Trap		Other		
Year	Wt	%[b]	Wt	%	Wt	%	Wt	%	Total
1973	116.6	21.6	31.7	5.9	392.4	72.6			540.7
1974	39.0	16.1	38.1	15.7	165.6	68.2			242.7
1975	149.9	22.7	82.0	12.4	427.9	64.9			659.8
1976	47.7	10.4	154.2	33.7	255.8	55.9			457.7
1977	49.8	16.9	98.3	33.4	145.7	49.4	0.9	0.3	294.7
1978	39.0	8.2	40.4	8.5	395.1	83.0	1.4	0.3	475.9
1979	158.7	11.7	132.7	9.8	1067.6	78.5			1359.0
1980	179.7	9.5	228.6	12.0	1488.3	78.5			1896.6
1981	238.1	8.7	90.4	3.3	2412.6	88.0			2741.1
1982	181.8	6.3	88.3	3.1	2595.2	90.1	16.5	0.5[c]	2881.8
1983	108.4	3.5	116.5	3.7	2901.2	92.3	15.6	0.5[d]	3141.7
1984	153.9	6.7	64.8	2.8	2082.2	90.5			2300.9
1985	298.9	13.0	135.1	5.9	1864.1	81.1			2298.1

[a]Fisheries Research Board of Canada Catch and Effort statistics of the Canadian Groundfish Fishery of the Pacific coast, 1973-1985.

[b]Percent of total landed by all gears within a year.

[c]Incidental to halibut longline.

[d]Includes troll, handline, sunken gillnet and catch incidental to halibut longline fishery.

Table 5.2. Canadian sablefish landings, by gear, from the west coast of Vancouver Island, 1973-1985 (round wt, metric tonnes)[a] excluding dumped and discarded fish.

	Gear type								
	Longline		Trawl		Trap		Other[b]		
Year	Wt	%[c]	Wt	%	Wt	%	Wt	%	Total
1973	3.2	0.8	50.9	12.5	353.4	86.7	Tr		407.5
1974	2.3	0.9	83.7	33.6	161.5	64.8	1.8	0.7	249.3
1975	2.3	0.9	200.3	81.8	41.5	16.9	0.9	0.4	245.0
1976	41.7	13.3	224.8	71.5	47.6	15.1	0.1	0.1	314.2
1977	27.3	3.5	688.4	87.1	68.9	8.7	5.9	0.7	790.5
1978	18.2	5.1	89.9	25.4	239.5	67.7	6.4	1.8	354.0
1979	118.3	17.5	143.4	21.2	409.8	60.5	6.0	0.9	677.5
1980	69.1	3.6	106.8	5.6	1722.5	90.6	3.0	0.2	1901.4
1981	94.8	8.6	140.2	12.8	862.4	78.6			1097.4
1982	161.9	13.2	153.2	12.5	913.3	74.2	1.9	0.2[d]	1230.3
1983	343.1	27.1	146.7	11.6	777.0	61.3			1266.8
1984	211.2	13.9	120.0	7.9	1188.9	78.2			1520.1
1985	159.4	8.4	93.9	5.0	1637.2	86.6			1890.5

[a]Fisheries Research Board Canada Catch and Effort Statistics of the Canadian Groundfish Fishery of the Pacific Coast, 1973-1985.

[b]Includes troll and handline.

[c]Percent of total landed by all gears within a year.

[d]Incidental to halibut longline.

Table 5.3. Sablefish total trap landings and LPUE estimates for January 1-April 30 and for all months combined for the three major fishing areas during 1977-1985.

	Vancouver Island				Queen Charlotte Sound				Queen Charlotte Islands			
	1st Qtr.		All Qtrs.		1st Qtr.		All Qtrs.		1st Qtr.		All Qtrs.	
Year	T.L.[a] (t)	LPUE (kg/trap)	T.L. (t)	LPUE (kg/trap)	T.L. (t)	LPUE (kg/trap)	T.L. (t)	LPUE (kg/trap)	T.L. (t)	LPUE (kg/trap)	T.L. (t)	LPUE (kg/trap)
1977	-	-	53.6	-	-	-	17.3	-	-	-	128.6	-
1978	-	-	141.3	25.2	-	-	77.6	11.6	-	-	326.4	20.1
1979	15.1	-	392.0	14.1	-	-	281.3	14.0	163.4	18.3	759.7	20.9
1980	275.7	16.9	1714.1	15.0	31.3	8.6	797.2	18.5	193.1	9.9	682.8	13.5
1981	240.1	12.5	860.6	10.3	198.7	22.4	1359.1	17.9	342.3	24.2	991.8	18.5
1982	222.0	12.6	913.3	11.8	369.1	16.8	1519.2	16.6	586.8	30.9	985.7	24.8
1983	87.7	16.3	770.0	13.7	18.7	11.6	1587.0	17.0	35.0	14.9	1285.2	17.9
1984	158.7	12.3	1188.9	11.7	340.3	22.6	1034.5	14.9	259.3	15.4	973.6	12.7
1985	513.9	20.5	1637.2	15.2	311.1	21.2	1054.2	20.3	404.3	31.0	710.3	19.6

[a] T.L. = Total landings.

Table 5.4. Summary of sablefish total trap landings and LPUE estimates for January 1-April 30 and for all months combined in B.C. waters from 1977-1985.

	Landing statistics			
	January 1-April 30		January 1-December 31	
Year	Total landings (t)	LPUE (kg/trap)	Total landings (t)	LPUE (kg/trap)
1977	-	-	214.6	-
1978	-	-	634.6	18.9
1979	181.7	18.3	1493.1	17.1
1980	502.1	12.4	3213.8	15.4
1981	781.3	18.8	3275.1	14.8
1982	1176.8	18.1	3342.6	16.5
1983	152.7	15.5	3678.0	16.5
1984	762.6	16.7	3275.4	13.0
1985	1271.7	22.1	3501.3	17.3

6.0 PACIFIC HAKE

by W. Shaw and M. Saunders

6.1. Coastwide

Yield options are not proposed on a coastwide basis.

6.2. Strait of Georgia

6.2.1. Landing statistics

During 1985, the fishery landed a total of 4976 t from the Strait of Georgia (Table 6.1). This total is an increase of 63% from the 1984 landings. Approximately 37% of the total was landed during the second quarter.

Preliminary 1986 landings indicate that, as in previous years, the majority of the catch comes from Minor Areas 14, 17, and 29 (Table 6.1). Until 1986, the catches were predominantly from Minor Area 17. In 1986 while second quarter catches remained at historic levels in Minor Areas 14 and 17, catches from Minor Area 29 have increased to 1030 t from 67 t in 1985 (Table 6.1). The total catch for Minor Area 29 in 1986 of 2711 t is well above the total catch for 1985 of 982 t (Table 6.1).

6.2.2. Condition of stock

There have been no new analyses conducted for the 1987 assessments. Sustainable yields have been calculated using Gulland's (1970) formula MSY = $a(M)(B_0)$.

LPUE has increased substantially (95%) in 1986 from 4.448 t/hr in 1985 to 8.675 t/hr (Table 6.2). Length frequencies collected in 1985 indicated little change in the size composition from the previous years. Modal sizes of hake ranged from 41-42 cm. Age composition data indicated that the 1978 year-class remained strong, contributing 28% to the catches.

Biomass estimates remain unchanged from those presented in the 1985 groundfish stock assessment (McFarlane and Shaw 1985).

6.2.3. Recommendations

Yield option 1:Sustained yield - low risk 10,000t
Yield option 2:Sustained yield - high risk 15,000t
Risk is a function of the range in possible values for biomass and natural mortality used in Gulland's formula for MSY. At catch levels near or above the 10,000 t level, the reproductive response of the stock to exploitation must be carefully monitored.

6.3. West coast of Vancouver Island

6.3.1. Landing statistics

Reported landings by all nations in the Canadian zone (Sub zones 5-1 and 5-2) were 24,962 t in 1985 (Table 6.3). This was a 41% decrease from 1984. This was a result of a foreign fishery being conducted only by the Polish fleet. As in the past, most of the catch was sold directly to foreign processing vessels. Canadian landings, as a part of a joint venture fishery with foreign fishermen, decreased from 1984 to 13,237 t. Domestic landings reported during 1984 totalled 1192 t.

The accuracy of reported landings continues to be suspect. Catch figures depend on both the reliability of foreign factory production figures and on the accuracy of product to round conversion factors. Efforts to verify catches through direct observation have been hampered by decreasing coverage and the inexperience of the observers employed. Checking of the trans-shipped product has also proved difficult. The accuracy of future assessments will rely heavily on the accuracy of catch information.

6.3.2. Condition of stock

Biological data collected in 1984 indicate that there is no change in the size composition of the offshore hake stock in the Canadian zone. The fishery continued to be supported by a series of strong year-classes. In particular, the 1980 and 1977 year-classes contributed about 23% and 34%, respectively, to the 1984 catch.

The methodology used to determine yield estimates of the offshore hake stocks in the Canadian zone is presented in detail in McFarlane and Francis (1985). The 1985 stock assessment, which incorporates 1985 catch data, is reported in Francis (1985). Some changes have been made, the most notable of which are simplification of the management model of Swartzman et al. (1983) and Francis et al. (1984) and the re-estimation of production parameters based on new fishery (1983, 1984) and NWAFC trawl/hydrographic survey (1983) data.

Francis (1985) recommends setting the ABC (Allowable Biological Catch) for the total (United States and Canada) stock at 405 thousand tonnes and the ABC for the Canadian portion of the stock at 105 thousand tonnes. This 74/26 split (U.S./Can.) is based on the 1980-84 average fraction of the total hake catch made in U.S. and Canadian waters, respectively, and has no biological significance.

We recommend that the split be made on the basis of marketable biomass present in the respective zones from the Eureka Area north. The Monterey Area is not included because it contains largely juvenile fish. The 1977 and 1980 surveys indicated tht 32.7% and 41.7%, respectively, of the marketable biomass was present in the Vancouver (INPFC) Area (McFarlane and Francis 1985). Using an average of 37.2%, the Canadian portion of the 405 thousand t ABC would be 150 thousand t.

The hake fishery, as mentioned earlier, is sustained by the 1977 and 1980 year-classes. Because of the strength of these year-classes and the apparent success of the 1984 year-class, the potential yield to the fishery is extremely high. Francis (1985) notes that at current low levels of harvest a minimum of 30 to 50 thousand t potential yield (coastwide) would be lost in 1987 due to low exploitation in 1986. Given recruitment is dependent on the infrequent occurrence of favourable environmental conditions (Bailey 1981), and mortality rates are relatively high, managers should be prepared to make hake when the sun shines.

6.3.3. Recommendations

High and low risk options reflect the uncertainty in (1) predicting accurately the success of recruiting age-classes, (2) in trawl estimates of biomass, and (3) the effect of the decreased size at age for those age-classes influenced by El Ni o.

High risk option: A quota of 150 thousand tonnes is considered high risk.

Low risk option: A quota of 75 thousand tonnes is considered low risk.

Table 6.1. Pacific hake landings (t) for the second quarter and whole year by Minor Areas 14, 17 and 29, and Major Area 48 during 1977-1986.

	1977		1978		1979		1980		1981		1982		1983		1984		1985		1986[a]	
Region	Q_2	Yr	Q_2	Yr	Q_2	Yr	Q_2	Yr	Q_2	Yr	Q_2	Yr	Q_2	Yr	Q_2	Yr	Q_2	Yr	Q_2	Yr
Minor Area																				
14	0	0	-	-	-	-	0	385	448	523	-	-	53	53	368	368	15	77	462	462
17	-	-	0	1	484	484	-	-	76	182	1927	2420	2208	2240	805	1736	1700	3718	1048	1120
29	-	-	0	0	2	2	0	5	810	1434	0	12	0	11	544	951	67	982	1030	2711
Major Area																				
48	0	0	1	2	486	516	1	508	1364	2409	1927	2824	3078	3122	1717	3056	1827	4976	2541	4295

[a]Preliminary landings/cut-off August 20, 1986.

Table 6.2. Pacific hake landings, CPUE and effort from the Strait of Georgia (Major Area 4B), 1977-1986.

Year	Total catch (t)	CPUE[a] (t/hr)	Effort[b] (hr)
1977	0.04	0.00	0
1978	2	0.00	0
1979	516	10.207	51
1980	508	4.583	111
1981	2409	8.937	270
1982	2824	4.796	589
1983	3121	4.465	699
1984	4599	6.780	678
1985	4976	4.448	1119
1986[c]	4295	8.675	495

[a]CPUE @ 25% qualification level.

[b]Effort = Total catch/CPUE.

[c]Preliminary catch/cut-off August 20, 1986.

Table 6.3. Total landings (t) of hake by foreign and domestic fishery off Canada (Area 3C) during 1978-1985.

		Total landings (t)			
Year	Nations	National	Joint venture	Domestic	Total
1978	Poland	589	1,814		
	USSR	700	0		
	Japan	3,364	0		
	Total	4,653	1,814	6,467	12,934
1979	Poland	4,263	3,102		
	USSR	0	1,131		
	Japan	3,637	0		
	Total	7,900	4,233	302	12,435
1980	Poland	4,456	4,560		
	USSR	78	4,300		
	Japan	817	0		
	Greece	0	3,355		
	Total	5,351	12,214	96	17,661
1981	Poland	3,189	4,779		
	USSR	227	7,342		
	Japan	187	0		
	Greece	0	4,927		
	Total	3,603	17,048	4,440	25,091
1982	Poland	10,357	10,222		
	USSR	0	9,391		
	Japan	2,237	0		
	Total	12,594	19,613	2	32,209
1983	Poland	13,177	13,464		
	USSR	0	14,192		
	Total	13,177	27,656	0	40,833
1984	Poland	13,203	9,214		
	USSR	0	19,692		
	Total	13,203	28,906	0	42,109
1985	Poland	10,533	13,237	1,192	
	Total	10,533	13,237	1,192	24,962

N.B. Catches reported in this fishery cannot be verified by weight tallies, as domestic catches are.

7.0 DOGFISH

by M. Saunders

7.0.1. General

7.1. Coastwide (not including Strait of Georgia)

7.1.1. Introduction

The offshore stock referred to in this assessment ranges from Alaska to California and does not include the Strait of Georgia-Puget Sound stock(s).

7.1.2. Landing statistics

Offshore landings of dogfish in 1985 continued to come from the trawl fishery (69.7%) in Major Area 3C (Table 7.1). The fishery is primarily (78.0%) during the first and second quarters (Table 7.2) when the large fish (> 80 cm) that processors demand are available to the fleet. Total landings have increased to 1959 t in 1985 (Table 7.1).

7.1.3. Condition of stock

The model of Wood et al. (1979) has been updated with catches to 1984 (Table 7.1, 7.3). The predicted pulse in abundance set in motion by the 1940's liver fishery (Saunders 1985) (Fig. 7.1.2 in Saunders 1985) is levelling out from the downward trend in abundance. At current harvest levels of less than 2000 t, the marketable biomass of dogfish is predicted to begin increasing (Fig. 7.1.3 in Saunders 1985) over the next two decades. The estimated biomass coastwide at the present time is approximately 300,000 t. If we assume that one-half to two-thirds of the stock resides off the coast of Canada, the biomass of fish in the Canadian zone is between 150,000-200,000 t.

7.1.4. Recommendations

In the previous assessment (Saunders 1985) strategies of sustained yield, sustained effort, and pulse fishing were evaluated. Regarding pulse or periodic fishing, the number of combinations of catch and duration were too numerous to present, hence it was recommended that periodic fisheries be evaluated at the time of their proposal.

Industry has expressed concern over the high abundance of dogfish, which is viewed as a nuisance, and has asked if it is possible to maintain the population at below nuisance levels while continuing to support a directed domestic fishery.

One of the control options proposed is pulse fishing. This is the removal of large quantities of fish at a specific time interval. Figure 7.1 illustrates the effect over time of removing a substantial catch in a single year. The biomass of marketable stock is capable of rebuilding to present levels within 3-4 years of removing 30,000 t and within 10 years of removing an unattainable figure of 210,000 t. The large removal, as discussed in Saunders (1985), accentuates and perpetuates the pulse in abundance introduced by the 1940's liver fishery. The extreme variation in abundance resulting from a pulse fishery is further illustrated by Figure 7.2, a forward

Table 7.1. Dogfish longline and trawl landings[a] (t) offshore, by Major Area and by gear for 1979-1985.

	3C			3D			5A			5B			5C			5D			5E			Total		
	LL	Tr	Tot.	LL	Tr	Tot.	LL	Tr	Tot.	LL	Tr	Tot	LL	Tr	Tot.	LL	Tr	Tot.	LL	Tr	Tot.	LL	Tr	Tot.
1979	4	279	283	1	15	16	5	10	15	-	5	5	1	11	12	26	70	96	-	-	-	33	390	423
1980	7	1732	1739	17	116	133	5	117	122	-	39	39	13	59	72	91	242	333	-	1	1	133	2306	2439
1981	10	285	295	-	17	17	-	25	25	-	-	-	-	9	9	10	32	42	-	-	-	20	368	388
1982	-	947	447	3	23	26	11	14	25	-	45	45	3	-	3	-	272	272	-	-	-	17	1301	1318
1983	77	451	528	-	54	54	16	-	16	-	9	9	-	3	3	-	17	17	-	-	-	93	534	627
1984	-	455	455	-	3	3	54	45	99	-	9	9	-	15	15	-	73	73	-	-	-	54	600	654
1985	-	1365	1365	60	74	134	360	52	412	38	2	40	-	-	-	4	4	8	-	-	-	462	1497	1959

[a]Interview and sales slip data from Smith 1980, 1981, Leaman 1982, 1983.

Table 7.2. Dogfish landings[a] (t) for Major Areas 4B and 3C, by gear and quarter for 1979 to 1985.

	Area 4B											Area 3C				
	Longline					Trawl						Trawl				
	Quarter					Quarter					Grand	Quarter				
	I	II	III	IV	Total	I	II	III	IV	Total	total	I	II	III	IV	Total
1979	747	206	419	2081	3453	9	7	106	669	881	4334	2	200	49	28	279
1980	806	482	23	229	1540	288	34	-	242	564	2104	512	1111	109	-	1732
1981	5	2	-	486	493	88	-	-	182	270	763	37	208	17	24	286
1982	302	67	6	464	839	100	28	120	171	419	1258	209	612	82	44	947
1983	273	128	55	336	792	81	111	70	173	435	1227	180	147	50	73	450
1984	353	260	347	635	1595	26	80	112	78	296	1891	239	127	67	22	455
1985	278	112	5	44	439	166	180	9	77	432	871	450	788	42	85	1365

[a]Includes sales slip information.

Table 7.3. Dogfish landings[a] (t) by gear from Washington State.

	Trawl	Longline	Other	Total
1983				
Inshore[b]	856	435		1271
Offshore[c]	21	5		26
1984				
Inshore	753	504	188	1445
Offshore	239	79	-	318
1985				
Inshore	469	363	139	971
Offshore	172	101	1	274

[a]From Technical Sub-committee, Washington State Status Reports, unpublished text.

[b]Major Area 4A.

[c]All Major Areas excluding 4A.

simulation of marketable biomass with catches of 60,000 t taken every fifth year. While 60,000 t keeps the population below the present level for 10 years, over the ensuing 25 years the stock fluctuates to well above present levels and to well below a level where commercial fishing is likely to be viable. The point when fishing is assumed to be non-viable is at the level of the predicted biomass in 1950, at the end of the liver fishery when as a result of heavy fishing pressure the abundance decreased to a level where fishing success was poor.

An alternative approach is to fish intensively for several years until the stock is below nuisance levels and then regulate catch to remove more fish in years when recruitment is high from the liver fishery pulse and vice versa when recruitment is decreasing. Figure 7.3 shows the effect of such a strategy in marketable biomass over time. Initial catches of 30,000 t for the first four years lower the stock rapidly and catches ranging from 8,000 to 25,000 t per year maintain a relatively stable stock size.

At current catch rates the trawl effort required to catch the tonnages involved is equivalent to the effort expended in a year by the entire groundfish trawl fleet on all species. One possibility is the establishment of a joint venture fishery to remove the difference of the yearly catch that domestic markets cannot utilize.

Possible options include unlimited yield, sustained yield, pulse fishing and a variable catch no-nuisance strategy as discussed under management strategies. The sustained yield option may be further divided with catches of up to 15,000 t (exploitation rate of 0.05) considered low risk and from 15,000-25,000 t (exploitation rate of 0.05-.08) high risk. The risk involved is based on ranges of compensatory mortality and starting stock sizes used to determine sustainable yields. All options refer to coastwide (including U.S.) removals and no provision has been made for adjusting Canadian catches in the event of increased U.S. landings.

7.2. STRAIT OF GEORGIA--PUGET SOUND

7.2.1. Introduction

This assessment treats the Strait of Georgia and Puget Sound as a single stock. The 1986 assessment remains unchanged from the previous assessment (Saunders 1985).

7.2.2. Landing statistics

Longline landings were down to 439 t in 1985 from 1595 t landed in 1984, while trawl landings increased from 296 t in 1984 to 432 t in 1985 (Table 7.2).

7.2.3. Condition of stock

The model of Wood et al. (1979) has been updated to include 1983 and 1984 catches. The model predicts that the downward trend in abundance has levelled off (Fig. 7.2.1 in Saunders 1985) and that at current harvest levels (approx. 3000 t) abundance should begin to increase sharply over the next ten to fifteen years (Fig. 7.2.3 in Saunders 1985). Current biomass levels are in

the order of 69,000 t.

Trends in relative abundance as indicated by LPUE, differ between longline and trawl data (Table 7.4). The trawl LPUE has increased steadily from 1980 to 1985 while the longline LPUE has fluctuated and dropped significantly in 1985. The trend indicated by trawl LPUE compares favourably with the trend predicted by the model.

Length-frequencies of fish from trawl and longline landings show no change in mean length of fish or in the maximum size of fish landed.

7.2.4. Recommendations

Yield options include unlimited yield, sustained yield, pulse fishing and a variable catch-no nuisance strategy. Regarding sustained yield, catches of up to 4000 t (exploitation rate of 0.06) are considered low risk, catches of 4000 to 6000 t (exploitation rate of 0.06-0.09) high risk and catches greater than 6000 non-sustainable. These are removals from the Strait of Georgia-Puget Sound complex. If we assume an even split in biomass between the Strait of Georgia and Puget Sound, catches of up to 2000 t can be considered low risk, 2000-3000 t considered high risk and catches greater than 3000 t considered non-sustainable for the Canadian portion of the stock.

Pulse fishing and the variable catch-no nuisance options are discussed under Coastwide Management Strategies.

Table 7.4. Dogfish LPUE[a] in the Strait of Georgia[b] by year by gear.

Year	LPUE	
	Longline[c]	Trawl[d]
1979	.613	.409
1980	.651	.276
1981	.747	.317
1982	.671	.446
1983	.837	.542
1984	1.050	1.434
1985	.299	3.388

[a] Excluding dumped and discarded fish, 25% qualification level.

[b] Excluding Minor Area 12.

[c] t/1000 hooks.

[d] t/hr

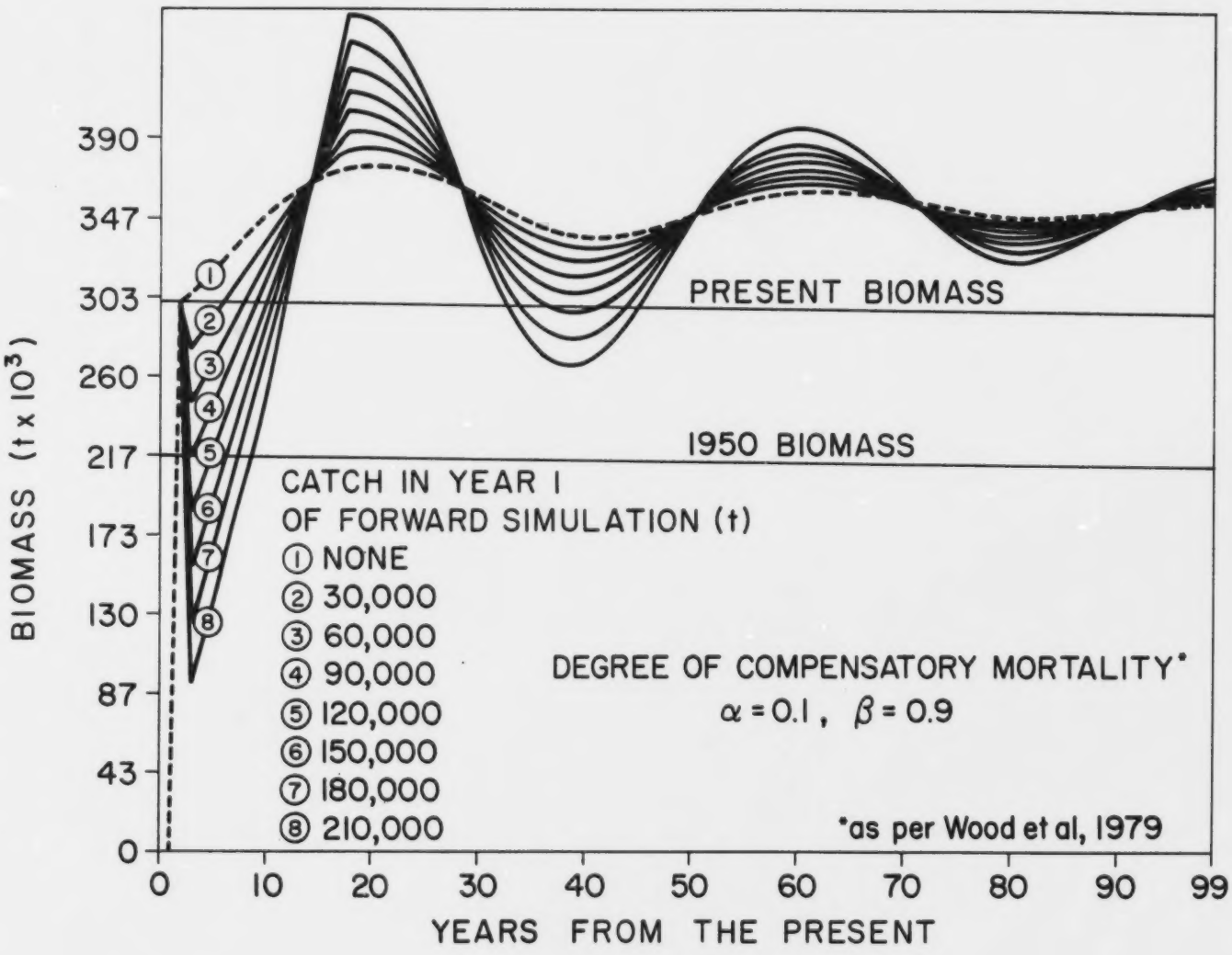

Fig. 7.1. Forward simulations of spiny dogfish marketable biomass offshore after a single year of intensive fishing.

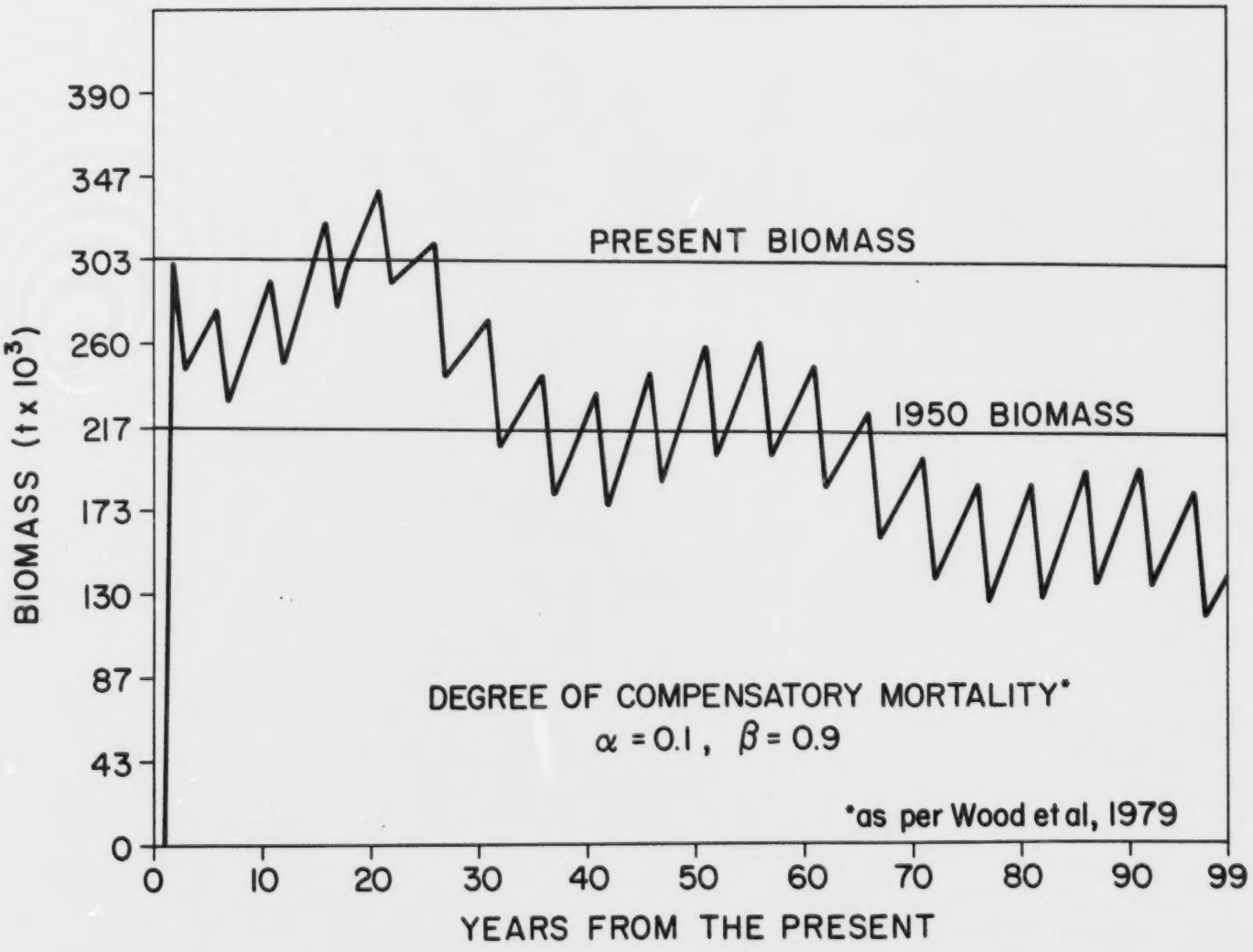

Fig. 7.2. Forward simulation of spiny dogfish marketable biomass offshore with catches of 60,000 t taken every fifth year.

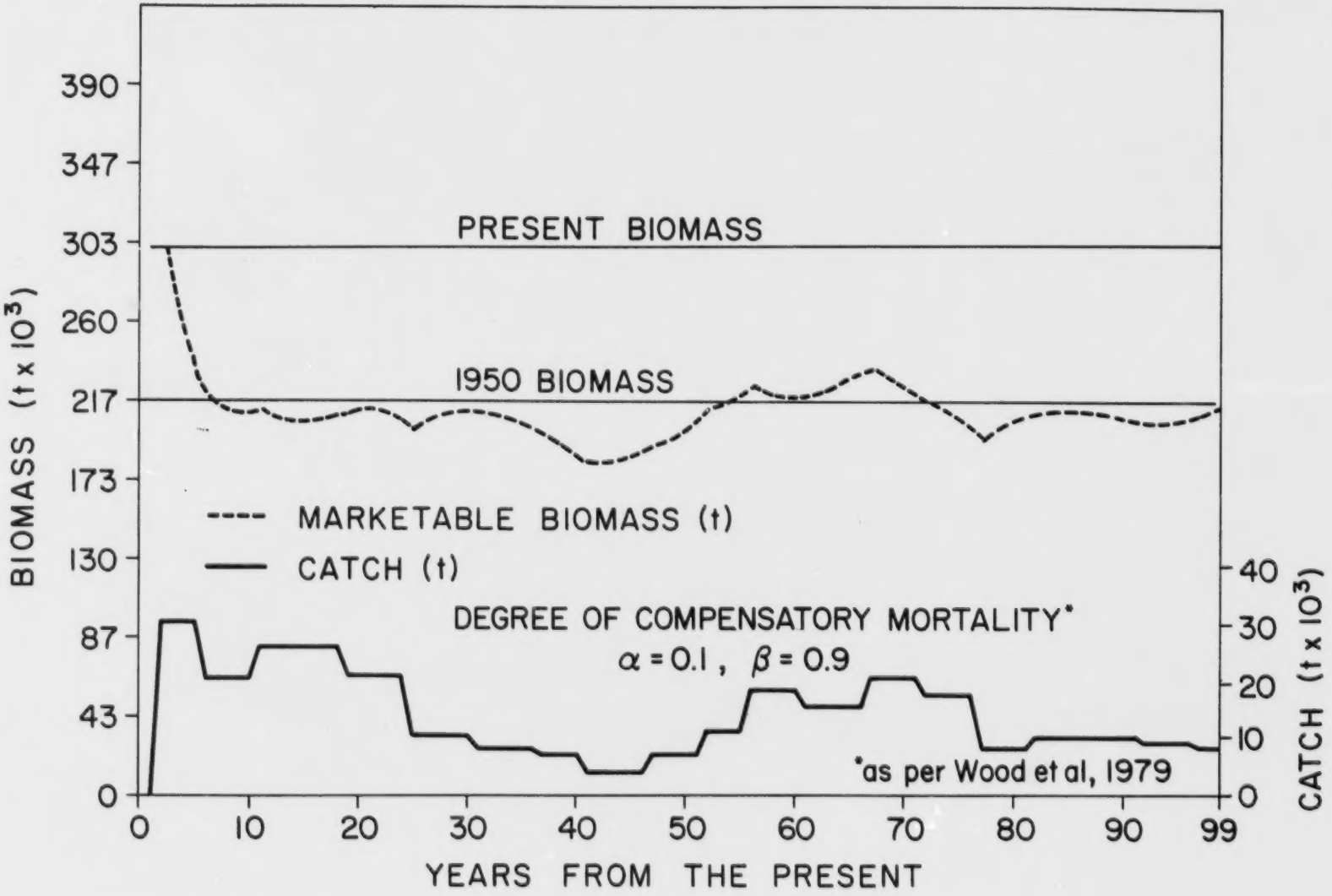

Fig. 7. 3. Forward simulation of spiny dogfish marketable biomass with catch levels adjusted to maintain the stock below nuisance and above commercially viable levels.

8.0 WALLEYE POLLOCK

by M. Saunders and W. Shaw

8.1. Coastwide

Yield options are not proposed on a coastwide basis.

8.2. Strait of Georgia

8.2.1. Landing statistics

Walleye pollock landings in the Strait of Georgia peaked in 1979 at 1,340 t. From 1982 to 1984, catches of walleye pollock in the Strait of Georgia dropped to less than 200 t. This was due to poor market conditions for the species. In 1985 total landings increased to 748 t (Table 8.1). The landings were predominantly from midwater trawlers, with approximately 54% of the landings occurring in April, and 45% in December. No landings were reported from Minor Area 18 (east of Mayne and Saturna Island area). There has been no demand for the pollock roe and all of the pollock catch was processed into frozen fillets.

8.2.2. Condition of stock

There have been no additional analyses conducted since the previous assessment (Shaw and Saunders in prep.). The assessment is based on Gulland's equation (Gulland 1970) where $MSY = a(M)(B_0)$.

Little change has occurred in the length frequencies collected in 1985 compared with those from the previous years. Modal size has ranged from 40-43 cm. Presumably the stock has remained in a stable condition.

8.2.3. Recommendations

Yield options for 1987 may be chosen from:

Yield option 1: conservative level of 2500 t
Yield option 2: high risk level of 5400 t

8.3. West coast Vancouver Island

8.3.1. Landing statistics

Walleye pollock remained an incidental catch in the 1985 joint-venture Pacific hake fishery in Major Area 3C. The incidental catch of pollock in 1985 by the foreign fleet decreased slightly from the 1984 landings to 80 t (Table 8.2). The landings by the domestic fishery still remain very low with 4 t landed in 1985 (Table 8.3).

8.3.2. Condition of stock

Length-frequency samples suggest that the size composition of the stock in 1985 has remained unchanged from the previous years. This indicates the relative stability of the stock (Table 8.4).

Table 8.1. Walleye pollock landings by gear type and by quarter from the Strait of Georgia (Major Area 4B), 1976-1985.

	Major Area 4B			
Year	Q_1	Q_2-Q_3	Q_4	Total
1976				
MWT[a]	-	-	-	0
BT[b]	3	<1	23	26
Total	3	<1	23	26
1977				
MWT	-	-	-	0
BT	24	1	26	51
Total	24	1	26	51
1978				
MWT	177	-	-	177
BT	142	20	41	203
Total	319	20	41	380
1979				
MWT	1033	-	3	1036
BT	283	1	20	304
Total	1316	1	23	1340
1980				
MWT	841	-	-	841
BT	189	3	23	215
Total	1030	3	23	1056
1981				
MWT	455	10	-	465
BT	99	1	5	105
Total	554	11	5	570
1982				
MWT	81	<1	-	81
BT	8	4	7	19
Total	89	4	7	100
1983				
MWT	19	-	-	19
BT	3	1	2	6
Total	22	1	2	25
1984				
MWT	8	57	90	155
BT	-	-	2	2
Total	8	57	92	157
1985				
MWT	401	4	319	724
BT	5	0	19	24
Total	406	4	338	748

[a] MWT = Midwater trawl.

[b] BT = Bottom trawl.

Table 8.2. Incidental catches of walleye pollock by foreign fleets participating in the offshore hake fishery off west coast Vancouver Island (Major Area 3C), 1980-1985. (Catch statistics from Offshore Division, Vancouver.)

		Landings (t)		
Year	Nations	National[a]	Joint venture	Total
1980	Poland	487	236	
	USSR	63	584	
	Japan	142	0	
	Greece	-	175	
	Total	692	995	1687
1981	Poland	131	205	
	USSR	26	299	
	Japan	9	0	
	Greece	-	285	
	Total	166	789	955
1982	Poland	468	222	
	USSR	0	149	
	Japan	38	-	
	Total	506	371	877
1983	Poland	13	6	
	USSR	-	-	
	Total	13	6	19
1984	Poland	1	66	
	USSR	-	41	
	Total	1	107	108
1985	Poland	2	78	
	Total	2	78	80

[a] "National" landings include landings from the supplementary fishery.

Table 8.3. Total landings (t) of walleye pollock by the domestic fleet by Major Statistical Area, 1954-85.

	Landings (t)									
Year	4B	3B	3C[a]	3D	5A	5B	5C	5D	5E	Total
1954	147	0	3	0	13	1	0	0	0	164
1955	418	0	5	0	1	0	0	3	0	426
1956	380	0	52	0	5	0	0	14	0	451
1957	248	0	4	0	3	0	0	7	0	262
1958	121	0	0	0	0.3	0	0	14	0	145
1959	260	0	8	0	0.4	0	0	2	0	270
1960	95	0	5	0	1	3	0	10	0	114
1961	115	0	0.1	0	1	0	0.3	7	0	123
1962	49	0	6	0	0	0	0	12	0	67
1963	13	0	7	0	6	0	0	4	0	29
1964	33	0	2	0	5	0	0	2	0	42
1965	26	0	10	0	0	0	0	9	0	45
1966	37	0	0.4	0	1	0.1	0.4	82	0	121
1967	33	1	0	0	1	0	7	48	0	90
1968	16	0	2	0	7	0	4	13	0	42
1969	30	0	14	0	33	0	0	47	0	125
1970	45	0	0	0	0	0	0	8	0	52
1971	80	0	5	0	0	0	0	0	0	85
1972	71	0	0.3	0	172	0	0	1	0	244
1973	9	0	0.1	0	62	9	0.4	13	0	93
1974	11	0	0	0	6	6	2	47	0	72
1975	1	0	0	0	21	10	1	70	0	104
1976	26	0	5	2	69	400	193	627	0.2	1,322
1977	50	0	10	0	61	175	16	568	12	891
1978	380	0	6	0.4	106	187	11	1,700	21	2,411
1979	1,341	0	31	0.3	72	71	238	1,566	67	3,385
1980	1,056	0	3	3	12	23	83	1,104	18	2,303
1981	570	0	8	1	2	10	80	563	22	1,255
1982	100	0	10	0	1	6	3	808	1	974
1983	25	0	3	1	11	10	6	986	28	1,070
1984	157	0	5	0	11	7	2	625	< 0.1	807
1985	748	0	4	0	0	1	0	1176	2	1,931

[a] Excludes incidental landings by the foreign fleet participating in the offshore Pacific hake fishery during 1980 to 1985.

8.3.3. Recommendations

The yield option remains unchanged from last year's (Shaw and Saunders 1986).

Yield option 1: no limitations imposed on catch.

8.4. Queen Charlotte Sound

Yield options are not proposed for this region.

8.5. Hecate Strait

8.5.1. Landing statistics

Walleye pollock landings in Major Area 5D in 1985 were 1176 t (Table 8.3). This was an increase of 88% from the 1984 landings. As in the past, landings were primarily from the first and fourth quarters. First quarter landings increased slightly in 1985 with 379 t landed (Table 8.4). Fourth quarter landings in 1985 were 755 t, up 179% from 1984. The demand for pollock fillets in 1985 was greater than in 1984.

Landings in Major Area 5C remain low due to directed fishing effort on the more northern fishing grounds.

8.5.2. Condition of stock

Size composition of the 1985 landings has remained relatively constant compared with the previous years. Modal sizes remained the same at 50-53 cm. Age-frequency data indicate that 5 and 7 yr-old pollock dominated the catches in 1984.

8.5.3. Recommendations

The yield option proposed for 1987 is the same as for 1986 (Shaw et al. 1985) that is, unlimited yield. The Canadian catch is currently limited by intermittent availability and/or weak market demand.

8.6. West Coast of Queen Charlotte Islands.

Yield options are not proposed for this region.

Table 8.4. Walleye pollock landings by gear type and by quarter from Major Areas 5C and 5D, 1976-1985.

	Major Area 5C				Major Area 5D			
Year	Q_1	Q_2-Q_3	Q_4	Total	Q_1	Q_2-Q_3	Q_4	Total
1976								
MWT[a]	-	25	102	127	-	208	56	264
BT[b]	<1	19	47	66	5	141	214	360
Total	<1	44	149	193	6	349	270	625
1977								
MWT	-	-	-	0	<1	<1	-	<1
BT	1	14	1	16	34	509	24	567
Total	1	14	1	16	34	509	24	567
1978								
MWT	-	1	-	1	425	299	71	795
BT	1	7	2	10	107	657	141	905
Total	1	8	2	11	532	956	212	1700
1979								
MWT	-	-	-	0	593	52	11	656
BT	1	103	134	238	119	521	270	910
Total	1	103	134	238	712	573	281	1,566
1980								
MWT	-	<1	-	<1	201	261	9	471
BT	1	73	9	83	116	482	34	632
Total	1	73	9	83	317	743	43	1,103
1981								
MWT	-	-	-	0	61	-	79	140
BT	27	21	31	79	71	248	104	424
Total	27	21	31	79	132	248	183	563
1982								
MWT	-	-	-	0	2	-	607	609
BT	<1	3	<1	3	4	98	97	199
Total	<1	3	<1	3	6	98	704	808
1983								
MWT	-	-	-	0	-	34	784	818
BT	-	6	-	6	43	46	79	168
Total	0	6	0	6	43	80	863	986
1984								
MWT	-	-	-	0	301	-	266	567
BT	-	2	-	2	13	40	5	58
Total	0	2	0	2	314	40	271	625
1985								
MWT	-	-	-	0	369	0	754	1123
BT	-	-	-	0	10	42	1	53
Total	0	0	0	0	379	42	755	1176

[a]MWT = Midwater trawl.
[b]BT = Bottom trawl.

9.0. SLOPE ROCKFISHES

B. M. Leaman

9.0.1. Introduction

There have been no additional analytical assessments conducted since the last assessment document. The only changes in recommendations and assessments arise from a review of the 1984-85 fishery. Tables 9.1 to 9.13 present landing statistics for each stock unit. In recent years there has been a decrease in the proportion of the catch for which detailed area and effort information has been obtained (Table 9.14). The reasons for vessel masters refusing this information are manifold and include:

- disagreements with stock assessments;
- disagreements with allocation strategies;
- protests against changes in the agreed Groundfish Management Plan in mid-year, without consultation; and
- protests against the Department's failure to enforce the Management Plan after acceptance by industry.

The impact of this non-cooperation has been twofold. First, it has required FRB staff to allocate landings to stock quotas based solely on indirect evidence. This evidence may have included any or all of surveillance flights, species composition of catches, biological characteristics of sampled fish from landings, time and distance calculations concerning trip length and catches, or verifiable sighting reports from other sources. Second, it has meant that an additional source of uncertainty has been introduced into our assessments, hence yield calculations. The cumulative result of these two factors has been a serious degradation, if not elimination, of the Department's ability to achieve stock-specific management. This is due to the fact that we do not have sufficient surveillance and enforcement capability, or at least allocation thereof, to achieve on-site management in the absence of cooperation in logbook reporting.

Table 9.15 presents stock-specific yield options and harvesting strategies for 1986. These figures are lower than the comparable 1985 estimates in response to the decreased precision of catch allocations. They reflect no change in assessment of the stocks and the intent is to provide recommendations that are consistent with the precision of management. Should the precision of catch allocation improve via increased logbook cooperation then managers may adjust quotas (to a maximum of the 1985 recommendations) to levels consistent with the precision of catch allocations.

The 1985 fishing year is the worst year on record in terms of our ability to allocate landings to quotas with confidence because non-cooperation was spread over landings from many stocks. While the problem is grave regardless of target stock, it is exacerbated by the grossly different productive capacities and current yield levels among geographically proximal stocks. At this point it does not appear that we shall receive an increase in our on-site enforcement capability and it seems prudent to consider what yield options are consonant with this diminished management capability.

9.1. Coastwide management

Yield options established on a coastwide basis are the natural

result of an inability to manage stocks separately. However, this seriously diminishes the potential to achieve particular management goals, such as rehabilitation of depleted stocks or maximum yield from less highly exploited ones. Several approaches to this problem were considered.

9.1.1. Area licensing:

Licensing of individual vessels to specific areas might serve the goal of distributing fishing effort but, in the absence of a corresponding partitioning of available quota, would not achieve harvest in proportion to the productivity of each area. Partitioning a coastwide quota into areas would result in very small quotas for some large areas and vice versa. In either case, particularly the latter, we would still be faced with a significant surveillance problem, one that is only slightly less acute than that with which we are presently faced. Primarily because of the surveillance requirement, we do not view area licensing as a viable solution to the present problems.

9.1.2. Quarterly or seasonal openings:

If there was a seasonal variation in the distribution of fishing effort, then seasonal or quarterly openings might permit some adaptive management response to achieve some stock-specific goals. It is, however, predicated on the assumption of cooperation in the allocation of landings and effort to stock units, which has been significantly incomplete in recent years. In addition, it is likely that seasonal openings would have an undesirable effect on concentration of fishing effort. This option would simply compress our present difficulties into a shorter time period.

9.1.3. Core area management:

This option embodies the concept of managing the coast as a whole but on the basis of a core production area, with no specific measures for other areas. In this case we are recommending coastwide yield options based on the production from the two "stocks" around Queen Charlotte Sound: Goose Island Gully/Mitchell's Gully and Moresby Gully. Table 9.16 presents these options for Pacific ocean perch. Operationally we are suggesting that, whatever yield option may be adopted, it be enacted as a coastwide quota and all landings be deducted from it. The attractiveness of this approach is twofold: firstly, it has a biological rationale and secondly, it provides an opportunity to achieve some management goals. The latter cannot be claimed for the other approaches.

The biological rationale for this option is that the ocean perch in these three gullies are extremely closely allied (Leaman 1985), if not in fact derivative, and thus are the only ocean perch stocks in B.C. waters that can be thought of as a linked production system. Examination of stocks in Area 5E suggests they are not self-supporting and may not be uniquely manageable. Area 3C/D ocean perch represent a problem that will require joint solution with the U.S.

The Queen Charlotte Sound stocks are at different productivity levels. Some achievement of multiple management goals could be realized through two measures. Firstly, if no ocean perch fishing were permitted before June then the Goose Island stock would gain protection at its most vulnerable stage

(spawning). Secondly, if all landings are deducted from this joint production quota then, at the extremes, either other areas will achieve some rehabilitation if all fishing occurs in Queen Charlotte Sound, or the Goose Island stock will achieve some rehabilitation if all fishing occurs elsewhere.

There can be no question that yields under coastwide options must be lower than the sum of the individual parts. We favour a reduced catch limit because it provides an opportunity to avoid having all stocks degrade to some lowest denominator yield level. The yield options presented in Table 9.16 are the sum of the unadjusted (i.e. 1985) individual yield options for the three gullies.

9.2. 5E(N) experiment

In an open-fishing regime we cannot endorse the continuation of the Langara open-fishing experiment because of the lack of compliance in reporting. We tentatively endorse a permit-licence surrender arrangement, similar to 1985, if it is enforced.

Yellowmouth rockfish

Yellowmouth rockfish coastwide quotas (Table 9.16) were formulated in the same manner as those for ocean perch.

Rougheye rockfish

Rougheye rockfish coastwide quotas (Table 9.16) were formulated with Area 5E(S) as the core production area.

Table 9.1. Estimated Pacific ocean perch landings from the INPFC Vancouver area, 1956-1985.

Year	Landings (t)				
	U.S.	Canada	Foreign	JV[a]	Total
1956	1,084	-	-	-	1,084
1957	1,154	-	-	-	1,154
1958	675	-	-	-	675
1959	968	-	-	-	968
1960	1,575	-	-	-	1,575
1961	2,479	6	-	-	2,485
1962	3,854	3	-	-	3,857
1963	3,767	2	-	-	3,769
1964	2,048	47	-	-	2,095
1965	2,961	7	500	-	3,468
1966	2,283	3	14,000	-	16,286
1967	783	7	12,678	-	13,468
1968	526	1	9,865	-	10,392
1969	528	2	2,827	-	3,357
1970	1,170	309	2,368	-	3,847
1971	627	230	2,738	-	3,595
1972	468	118	1,981	-	2,567
1973	308	0	3,479	-	3,787
1974	255	3	1,186	-	1,444
1975	308	6	504	-	818
1976	729	1	521	-	1,251
1977	897	16	T	-	913
1978	958	56	-	-	1,014
1979	616	125	-	-	741
1980	397	430	-	8	835
1981	234	548	5	3	790
1982	309	514	6	1	830
1983	266	837	44	-	1,147
1984	541	744	-	6	1,291
1985	N/A	616	N/A	N/A	616

[a]Joint-venture.

Table 9.2. Canadian interviewed landings (t), effort (h), and LPUE (t/h) of Pacific ocean perch (Sebastes alutus) from Area 3C.

	Area 3C						
		Interviewed					
		0% Qualification			25% Qualification[a]		
Year	Total landings	L	E	LPUE	L	E	LPUE
1967	4.47	4.47	6.5	0.687	4.28	4.5	0.951
1968	0.12	0.12	6.3	0.018	-	-	-
1969	-	-	-	-	-	-	-
1970	298.84	296.77	444.8	0.667	273.11	293.2	0.932
1971	206.99	201.14	552.0	0.364	190.50	333.7	0.571
1972	72.24	13.25	21.3	0.624	12.67	14.3	0.889
1973	-	-	-	-	-	-	-
1974	-	-	-	-	-	-	-
1975	5.46	5.46	166.5	0.033	1.46	7.0	0.208
1976	1.29	1.29	5.0	0.257	0.87	1.0	0.869
1977	15.04	13.81	447.5	0.031	8.67	42.3	0.205
1978	48.88	48.57	57.8	0.841	47.51	32.0	1.485
1979	80.62	79.91	147.1	0.543	77.14	44.9	1.718
1980	285.59	284.77	448.2	0.635	277.93	234.9	1.183
1981	381.54	364.99	750.8	0.486	341.61	430.5	0.794
1982	395.23	372.29	740.3	0.503	342.56	430.7	0.795
1983	373.97	179.30	348.3	0.515	167.71	143.3	1.171
1984	406.17	317.39	481.9	0.659	316.86	478.8	0.662
1985	275.82	255.55	1079.6	0.237	235.35	783.2	0.301

[a]At least 25% of landing must be S. alutus for inclusion of data.

Table 9.3. Canadian interviewed landings (t), effort (h), and LPUE (t/h) of S. alutus from Area 3D.

Area 3D							
		Interviewed					
		0% Qualification			25% Qualification[a]		
Year	Total landings	L	E	LPUE	L	E	LPUE
1967	2.55	2.55	10.0	0.255	2.55	10.0	0.255
1968	0.41	0.04	66.5	0.001	-	-	-
1969	2.49	2.49	40.5	0.062	1.26	12.5	0.101
1970	5.38	5.38	150.6	0.036	-	-	-
1971	11.39	11.39	82.0	0.139	10.32	67.0	0.154
1972	45.02	-	-	-	-	-	-
1973	-	-	-	-	-	-	-
1974	2.92	2.92	59.0	0.050	-	-	-
1975	-	-	-	-	-	-	-
1976	-	-	-	-	-	-	-
1977	1.13	1.13	7.3	0.155	0.14	4.0	0.034
1978	7.05	4.48	18.9	0.237	3.45	6.9	0.499
1979	44.24	44.24	53.9	0.820	43.89	40.8	1.076
1980	144.26	143.50	300.9	0.477	126.80	190.1	0.667
1981	165.97	165.97	353.4	0.470	163.40	283.4	0.577
1982	112.86	112.13	200.8	0.558	109.92	124.3	0.884
1983	463.33	214.39	574.3	0.373	182.58	281.6	0.648
1984	337.40	236.03	441.8	0.534	231.60	353.3	0.656
1985	339.99	289.81	506.2	1.396	247.56	358.40	0.691

[a]At least 25% of landing must be S. alutus for inclusion of data.

Table 9.4. Total landings (foreign and domestic) of Pacific ocean perch, standardized LPUE and calculated total effort on the principal fishing grounds of Queen Charlotte Sound. (Fishery changed to winter fishery on spawning females in 1983.)

	Goose Island Gully			Mitchell's Gully		
Year	Total landings (t)	Standard LPUE (t/h)	Calculated effort (h)	Total landings (t)	Standard LPUE (t/h)	Calculated effort (h)
1959	1,890	0.836	2,261	-	-	-
1960	1,679	0.698	2,405	-	-	-
1961	1,199	0.797	1,504	-	-	-
1962	1,838	1.161	1,583	-	-	-
1963	3,712	1.457	2,548	-	-	-
1964	3,450	1.134	3,042	57	-	-
1965	7,478	1.491	5,015	488	0.780	626
1966	20,752	1.441	14,401	1,369	0.815	1,680
1967	12,119	1.068	11,347	5,319	1.157	4,597
1968	10,213	1.045	9,773	2,556	1.137	2,248
1969	6,872	0.763	9,007	2,945	0.995	2,960
1970	6,489	0.672	9,657	1,296	1.010	1,283
1971	3,455	0.526	6,568	813	0.954	852
1972	5,645	0.829	6,809	995	0.854	1,165
1973	3,755	0.773	4,858	2,264	1.351	1,676
1974	7,269	0.773	9,404	1,917	0.974	1,968
1975	4,209	0.507	8,302	1,151	0.989	1,164
1976	2,442	0.733	3,332	576	0.673	856
1977	1,693	0.660	2,565	256	0.551	465
1978	865	0.821	1,054	375	0.817	459
1979	951	0.799	1,190	480	0.670	716
1980	1,226	0.932	1,316	305	0.862	354
1981	801	0.760	1,054	680	4.474	152
1982	570	0.514	1,110	286	2.648	108
1983	1,215	1.257	967	31	0.929	33
1984	841	2.017	417	19	0.594	32
1985	759	0.615	1234	80	0.149	537

Table 9.5. Yellowmouth rockfish (S. reedi) interviewed and total landings (t), effort (h) and LPUE (t/h) in Goose Island and Mitchell's gullies.

Year	Total landings	Interviewed					
		0% qualification			25% qualification[a]		
		L	E	LPUE	L	E	LPUE
1971	5.35	5.35	31.5	0.170	-	-	-
1972	-	-	-	-	-	-	-
1973	176.65	176.65	37.0	4.774	176.21	32.5	5.422
1974	78.91	78.91	23.0	3.431	78.91	23.0	3.431
1975	1.08	1.08	34.5	0.031	-	-	-
1976	12.29	12.29	10.0	1.229	12.29	10.0	1.229
1977	335.89	335.89	466.0	0.721	331.29	226.3	1.464
1978	16.54	16.54	110.0	0.150	10.86	16.0	0.679
1979	10.25	10.25	102.0	0.101	6.49	9.7	0.669
1980	27.92	27.92	97.5	0.286	24.77	32.7	0.758
1981	4.74	4.74	25.6	0.185	0.07	2.0	0.033
1982	191.86	176.94	167.5	1.056	163.42	39.8	4.111
1983	528.64	455.57	492.2	0.926	367.12	151.4	2.424
1984	343.93	87.25	288.7	0.302	69.45	130.1	0.534
1985	304.82	52.84	413.3	0.128	37.67	43.7	0.863

[a]At least 25% of landing must be S. reedi for inclusion of data.

Table 9.6. Pacific ocean perch interviewed landings, effort, and LPUE (t/hr) from Moresby Gully.

Year	Interviewed			Total landings
	Landings (t)	Effort (hr)	LPUE (t/h)	
1966	-	-	-	0.33
1967	-	-	-	-
1968	-	-	-	-
1969	-	-	-	-
1970	-	-	-	-
1971	2.00	10.0	0.200	1.50
1972	-	-	-	-
1973	-	-	-	-
1974	10.12	11.3	0.896	10.12
1975	93.64	91.3	1.026	96.75
1976	39.67	109.0	0.364	43.40
1977	3.71	8.5	0.436	41.13
1978	162.30	155.3	1.045	162.30
1979	223.83	215.9	1.037	225.35
1980	2145.76	1540.4	1.393	2432.59
1981	1479.57	1019.5	1.451	2166.30
1982	2711.59	1346.0	2.015	3561.99
1983	1491.27	641.4	2.325	2204.22
1984	1274.35	820.6	1.553	2042.18
1985	1311.35	1006.2	1.303	1939.39

Table 9.7. Sebastes reedi interviewed and total landings (t), effort (h), and LPUE (t/h) in Moresby Gully.

Year	Total landings	Interviewed					
		0% qualification			25% qualification[a]		
		L	E	LPUE	L	E	LPUE
1978	91.94	91.94	54.3	1.693	84.65	45.2	1.873
1979	20.48	20.48	37.6	0.545	-	-	-
1980	20.13	20.13	28.7	0.702	1.50	5.5	0.272
1981	109.67	40.95	116.6	0.351	-	-	-
1982	417.32	325.15	711.6	0.457	228.75	202.1	1.132
1983	202.04	78.24	329.7	0.237	15.22	39.8	0.383
1984	338.09	106.12	308.1	0.344	34.73	50.2	0.692
1985	231.79	177.29	342.2	0.518	113.98	85.1	1.340

[a]At least 25% of landing must be S. reedi for inclusion of data.

Table 9.8. Canadian landings (t), effort (h), and LPUE (t/h) of S. alutus, from Area 5E, south of 54°.

	Area 5E						
		Interviewed					
	Total	0% qualification			25% qualification[a]		
Year	landings	L	E	LPUE	L	E	LPUE
1976	78.78	78.78	59.0	1.335	78.78	59.0	1.335
1977	1549.42	1475.24	1041.5	1.416	1321.29	651.4	2.028
1978	2413.70	2346.93	1043.9	2.248	2255.89	724.4	3.114
1979	839.28	839.28	557.4	1.506	823.09	376.1	2.188
1980	876.96	472.90	496.2	0.953	449.31	332.5	1.351
1981	599.21	432.73	235.7	1.836	412.99	172.5	2.394
1982	614.11	606.73	443.1	1.369	550.38	308.8	1.782
1983	835.17	762.67	629.8	1.211	721.46	403.8	1.787
1984	840.88	457.92	344.8	1.328	434.90	215.9	2.015
1985	830.04	605.36	691.5	0.875	564.34	453.8	1.243

[a]At least 25% of landing must be S. reedi for inclusion of data.

Table 9.9. Canadian landings (t), effort (h), and LPUE (t/h) of S. reedi, from Area 5E, south of 54°.

	Area 5E south						
		Interviewed					
	Total	0% qualification			25% qualification[a]		
Year	landings	L	E	LPUE	L	E	LPUE
1976	-	-	-	-	-	-	-
1977	1256.74	1256.74	583.0	2.156	1226.64	438.2	2.799
1978	1104.64	1104.64	600.4	1.840	858.89	296.3	2.899
1979	388.54	388.54	356.5	1.090	328.72	204.7	1.606
1980	499.91	477.23	321.5	1.484	477.23	321.5	1.484
1981	922.41	380.12	192.2	1.978	350.89	129.9	2.701
1982	414.39	351.87	335.9	1.048	307.98	191.9	1.605
1983	588.21	556.22	575.5	0.966	501.10	356.7	1.405
1984	441.08	212.33	336.2	0.632	169.75	178.9	0.949
1985	497.31	346.48	609.8	0.568	221.23	257.8	0.858

[a]At least 25% of landing must be S. reedi for inclusion of data.

Table 9.10. Canadian landings (t), effort (h), and LPUE (t/h) of rougheye rockfish (S. aleutianus) from Area 5E, south of 54°.

	Area 5E south						
		Interviewed					
	Total	0% qualification			25% qualification[a]		
Year	landings	L	E	LPUE	L	E	LPUE
1976	-	-	-	-	-	-	-
1977	76.28	76.28	134.5	0.567	74.69	66.0	1.132
1978	139.49	139.49	396.9	0.351	105.17	118.3	0.889
1979	192.09	192.09	347.7	0.552	159.51	137.1	1.163
1980	51.42	51.42	60.0	0.857	50.31	23.0	2.187
1981	9.93	9.93	46.2	0.215	5.13	7.2	0.713
1982	274.38	274.38	269.3	1.019	262.55	156.2	1.681
1983	74.16	61.37	324.1	0.189	26.70	22.0	1.214
1984	100.85	73.31	215.3	0.341	21.49	24.2	0.889
1985	160.56	118.37	411.9	0.287	70.41	151.2	0.466

[a]At least 25% of landing must be S. aleutianus for inclusion of data.

Table 9.11. Canadian landings (t), effort (h), and LPUE (t/h) of S. alutus, from Area 5E, north of 54°.

	Area 5E north						
		Interviewed					
	Total	0% qualification			25% qualification[a]		
Year	landings	L	E	LPUE	L	E	LPUE
1976	-	-	-	-	-	-	-
1977	1.42	1.42	19.7	0.072	0.7	2.3	0.304
1978	22.22	22.22	151.1	0.147	6.65	16.8	0.396
1979	227.49	227.49	177.5	1.282	223.83	108.5	2.063
1980	84.56	84.56	119.3	0.709	64.80	39.5	1.641
1981	109.22	63.58	32.4	1.962	53.15	24.1	2.205
1982	342.23	218.48	144.1	1.516	194.18	109.3	1.777
1983	291.98	226.43	401.8	0.564	208.28	193.5	1.076
1984	2173.86	1819.93	1213.5	1.500	1779.38	980.0	1.816
1985	1938.46	1838.86	1908.7	0.963	1728.49	1514.5	1.141

[a]At least 25% of landing must be S. alutus for inclusion of data.

Table 9.12. Canadian landings (t), effort (h), and LPUE (t/h) of S. reedi from Area 5E, north of 54°.

	Area 5E north						
		Interviewed					
		0% qualification			25% qualification[a]		
Year	Total landings	L	E	LPUE	L	E	LPUE
1976	-	-	-	-	-	-	-
1977	-	-	-	-	-	-	-
1978	-	-	-	-	-	-	-
1979	16.86	16.86	69.9	0.241	4.08	4.1	0.995
1980	-	-	-	-	-	-	-
1981	2.34	2.34	4.9	0.478	2.34	4.9	0.478
1982	67.88	54.58	70.3	0.776	52.36	36.5	1.435
1983	52.23	18.36	44.5	0.413	3.48	9.0	0.387
1984	72.84	63.05	468.3	0.135	15.79	14.9	1.061
1985	180.31	174.03	1008.3	0.173	55.12	40.5	1.360

[a]At least 25% of landing must be S. reedi for inclusion of data.

Table 9.13. Canadian landings (t), effort (h), and LPUE (t/h) of S. aleutianus from Area 5E, north of 54°.

	Area 5E north						
		Interviewed					
	Total	0% qualification			25% qualification[a]		
Year	landings	L	E	LPUE	L	E	LPUE
1976	-	-	-	-	-	-	-
1977	-	-	-	-	-	-	-
1978	-	-	-	-	-	-	-
1979	13.99	13.99	139.5	0.100	9.73	64.1	0.152
1980	2.58	2.58	42.5	0.061	-	-	-
1981	98.08	98.08	26.0	3.772	94.20	23.0	4.100
1982	69.09	69.09	74.4	0.929	65.66	34.8	1.887
1983	127.46	84.01	271.5	0.309	43.39	44.3	0.979
1984	226.21	207.86	824.7	0.252	93.50	134.3	0.696
1985	465.37	464.95	1344.4	0.346	317.35	397.2	0.799

[a]At least 25% of landing must be S. aleutianus for inclusion of data.

Table 9.14. Rockfish total landings and % for which logbook records received 1981-1985.

Year	Total landings (t)	Interviewed landings (t)	% interviewed
1977	7615	7399	97
1978	10103	9858	98
1979	8394	8081	96
1980	9505	8443	89
1981	9484	6746	71
1982	10844	8911	82
1983	12316	8632	70
1984	14652	9545	65
1985	17127	12403	72

Table 9.15. Yield options (t) for slope rockfishes (S. alutus, S. reedi, S. aleutianus). Yields in tonnes.

Area	Species	Cluster options	Harvest strategy		
			Conservative	Sustainable	Non-sustainable
3C	S. alutus	A	n.d.[a]	210	350
3D	S. alutus	A	175	245	350
5A/B (Goose Is. & Mitchell's gullies)	S. alutus	A	595	735	910
	S. reedi	A	140	245	350
	Slope rockfish	C	735	980	1260
5C (Moresby Gully)	S. alutus	A	1190	1400	1750
	S. reedi	A	140	175	210
	Slope rockfish	C	1330	1575	1960
5E(S)	S. alutus	A	280	420	700
	S. reedi	A	280	420	700
	S. aleutianus	A	70	175	350
Jan.-Jun.	Slope rockfish	C	210	350	630
Sep.-Dec.	Slope rockfish	C	420	630	910
5E(N)	S. alutus	A	0	n.d.	140
	S. aleutianus	A	0	n.d.	175
	Slope rockfish	C	0	n.d.	315

[a] n.d. -- non-directed fishery

Table 9.16. Coastwide yield options (t) for selected slope rockfish.

	Harvest strategy		
Species	Conservative	Sustainable	Non-sustainable
S. alutus (Jun.-Dec.)	2550	3050	3800
S. reedi	400	600	800
S. aleutianus	100	250	500

10.0 Shelf rockfish (silvergray, yellowtail, canary rockfish)

by R. Stanley

10.0.1 Introduction

The 1985 stock assessment report on shelf rockfish (Stanley 1985) explained how the lack of biological and historical catch information for these fisheries precludes the use of the standard analytical assessment techniques. I resorted instead to calculating mean yield over the history of the fishery and then recommending yield options as some proportion of the mean yield depending on evidence for or against overfishing.

This situation is unchanged for the 1986 recommendations but I have attempted in the following section to more rigorously specify the methodology and outline a set of criteria for deriving the proposed options.

The derivation of the minimum estimate of sustainable yield and adjusted estimate of sustainable yield requires 3 steps:

(1) calculate mean yield from the history of the fishery;

(2) examine biological data and catch rates for symptoms of overfishing;

(3) adjust mean yields depending on step (2) and the expectation of receiving future information with which to monitor the fishery.

All assessments were based on catch information to mid-1985. Complete 1985 information was added subsequently.

Calculation of mean yield

The issue to be resolved in this calculation is deciding how many years of data to include. Since the degree of juvenescence is probably the most reliable symptom of overfishing available from our information, the catch history should include the exploitation of all year-classes which still can be expected to persist in the fishery at the time of examination. With an instantaneous mortality rate of 0.20, an average year-class would persist after recruitment for approximately 15 years (mortality = 95%). Most rockfish begin to enter the fishery 5-10 years before they are fully recruited, so this would imply using the preceding 20 years of catches, to trace the history of a year-class. We do not have reliable statistics for shelf rockfish landings by species prior to 1967, 19 years ago, so for each stock I have calculated mean yield from all years for which we have information, even though there has been an inadequate period of time for data collection.

Symptoms of overfishing

Since the traditional analytical techniques of stock assessment are not possible, the only method that remains is to examine the length frequency data for obvious signs of juvenescence either as a trend or in comparison with an expected length frequency for a given theoretical mortality rate. If some ageing can be conducted, this material can be used to establish whether an increasing proportion of young fish is a result of a large incoming year-class. Archibald et al. (1981) suggest a natural instantaneous rate of

0.05 or slightly lower for male and female silvergray (S. brevispinis) and male canary (S. pinniger) rockfish. This would imply that mortality rates which consistently exceed 0.15-0.20 indicate overfishing. Mortality rates of female canary rockfish were harder to determine because of limited data, but available information indicates a range of 0.11-0.24. For this group, I assumed that estimated mortality rates consistently in excess of 0.30 would represent overfishing. Length frequency data were also examined for simple trends or to compare current distribution with results in other fisheries (i.e., U.S. fisheries.)

The second indication of stock status is LPUE. While the landings history of some of the stocks goes back 19 years, effort data is only reliable in the years since these fisheries began to be significantly exploited by Canadian trawlers in the 1980s. The rates were examined for general trends especially if LPUE estimates were based on more than 400-500 hours of effort per year.

Adjustment of mean yields

I modified the harvest guidelines which were used by Golden and Demory (1984) for canary rockfish as follows:

1. For stocks with a history of moderate exploitation where catches are stable and it can be observed that no consistent signs of biological stress are present, allow for an annual catch at some percentage above the average catch. The new yield should be maintained for 3-5 years before further increments.

2. If catches have undergone a recent (5-year) substantial increase over the long-term average and no consistent signs of stress are present, then use a value between the long-term average before the increase and the peak catch. The actual point chosen within that range would vary as outlined below.

3. If catches have peaked or show signs of stress (juvenescence or declining catch rates) reduce the current yield.

The amount that catches could be increased should be considered relative to the current yield, the confidence with which one can infer that overfishing is not occurring, and the expectation of receiving resource information in the future which will allow monitoring of the impact of increased yields.

Shelf rockfish fisheries that have produced mean yields of 0-200 t could be increased to a maximum of 200%; for mean yields of 200-400 t, the maximum could be 150% and for fisheries which have yielded greater than 400 t, yield can be increased up to 130%. The different maxima will allow managers to test productivity of lesser fisheries without risking proven stocks. The percentage is a decreasing series to reduce the risk of overfishing as catches grow. Whether the full maxima are used is determined by apparent health of the stock or whether information is available for an assessment.

Conservative yield options are set at one-half the sustainable level. The non-sustainable level is set at 150 or 200% of the sustainable

current yield level depending on the amount of information available for assessing the stock's condition; and the apparent stock status.

Once a year's quota is filled, rockfish continue to be captured incidental to other target fisheries. Managers have generally responded to this problem by permitting an "incidental" trip limit of 10,000 to 40,000 lbs. The yearly quota should be set as some proportion of the chosen yield option. The proportion will depend on what managers view as a reasonable "incidental" limit and the number of these trips expected after the quota is filled.

10.0.2. Landing statistics

Industry representatives suggested in recent meetings that historical U.S. rockfish landings from Canadian waters were significantly greater than those summarized in the Stock Assessment documents. I think the confusion lies in attempting to compare their impression of the total number of rockfish landings for all rockfish species for all areas with the individual catch histories by each species by each area presented herein. To show that the assessment does account for large U.S. landings, I have included Table 10.1 which summarizes catches for all rockfish for all areas.

10.1. Coastwide

Coastwide quotas for shelf rockfish, as for the slope forms, reflect concern about the effects of an entire quota being removed from only one of the stocks. If a coastwide quota is chosen, instead of area management, I recommend that the coastwide quotas be lower than the sum of the individual quotas for the traditionally productive areas. It should be remembered that the area quotas represent in some cases experimental increases over the proven productive capacity.

The derivation of area options is discussed on subsequent pages. Area options are summarized in Table 10.2.

10.1.1. Silvergray rockfish

Proposed coastwide yield options for silvergray rockfish are 700 (conservative), 1350 (sustainable), and 2000 t (non-sustainable). These compare with a summed yield of approximately 1800 t if sustainable yields by area were in effect for 1986. Mean yield for the coast has been approximately 1300-1400 t, depending on which years are used for each area. The 1350 t also represents the sum of the sustainable options for Queen Charlotte Sound, currently the main area of production.

I recommend that there be unlimited fishing on the silvergray stock in the experimental Pacific ocean perch fishery off Langara Island until the conclusion of that experiment.

10.1.2. Yellowtail rockfish

Proposed coastwide yield options for yellowtail rockfish are 750 (conservative), 1500 (sustainable), and 2250 t (non-sustainable). This reflects the Queen Charlotte Sound quota. Coastwide catches have failed to reach the sustainable level for a number of years.

Table 10.1. Total rockfish landings (t) by U.S. trawlers from Canadian waters (1960-1979).

Year	Pacific ocean perch complex[a]	Other rockfish	Total
1960	1618	2923	4541
1961	1605	2944	4549
1962	2026	4219	6245
1963	4356	6019	10375
1964	3706	5035	8741
1965	4575	6256	10831
1966	6413	3287	9700
1967	5790	2668	8458
1968	4893	3085	7978
1969	5139	5829	10968
1970	5207	4568	9775
1971	3141	3786	6927
1972	3594	4103	7697
1973	2683	4820	7503
1974	2451	3118	5569
1975	1109	2006	3115
1976	932	2550	3482
1977	1500	2918	4418
1978	140	1520	1660
1979	395	1357	1752

[a]Principal species in the Pacific ocean perch complex include predominantly Pacific ocean perch, redstripe rockfish and yellowmouth rockfish, (Tagart and Kimura 1982).

Table 10.2. Yield options (t) for shelf rockfish (silvergray, yellowtail, canary).

Area	Species	Option	Harvest strategy		
			Conservative	Sustainable	Non-sustainable
3C	Silvergray	A	non-directed	100	200
	Yellowtail		n.d.	100	200[a]
	Canary		n.d.	200	300[a]
	Shelf rockfish	C	n.d.	300	450[a]
3D	Silvergray	A	150	350	700
	Yellowtail		n.d.	150	250
	Canary		300	550	800
	Shelf rockfish	C	400	850	1600
5A+B	Silvergray	A	400	750	1100
	Yellowtail		500	1500	2500
	Canary		250	500	750
	Shelf rockfish[b]	B	500	1100	1700
	Yellowtail		500	1500	2500
5C	Silvergray	A	300	600	900
	Yellowtail		100	200	400
	Canary		150	250	500
	Shelf rockfish[c]	B	200	400	800
	Silvergray		300	600	900

Table 10.2. (cont'd)

Area	Species	Option	Harvest strategy		
			Conservative	Sustainable	Non-sustainable
5D	Silvergray	A	combined with Area 5C		
	Yellowtail		150	350	500
	Canary		n.d.	100	200
	Shelf rockfish[c]	B	150	400	600
5E(N)	Silvergray		----------100[d]----------		
	Yellowtail	A	----------200[d]----------		
	Canary		----------200[d]----------		
	Shelf rockfish	C	----------200[d](or free fishing)-		
5E(S)	Silvergray	A	----------350[d]----------		
	Yellowtail		----------200[d]----------		
	Canary		----------400[d]----------		
	Shelf rockfish	C	----------950[d]----------		

[a]Joint international quotas recommended if yields exceed suggested non-sustainable levels.

[b]Silvergray and canary.

[c]Yellowtail and canary.

[d]Little knowledge of resource status.

A = single species.

B = partial clustering of selected species considered under A.

C = full clustering of all species.

10.1.3. Canary rockfish

Proposed coastwide yield options for canary rockfish are 550 (conservative), 1050 (sustainable), and 1600 t (non-sustainable). The sustainable level represents the sum of the two traditional sources, southern Queen Charlotte Sound and the northwest coast of Vancouver Island. The mean coastwide yield has been approximately 1000 t. These figures compare with an expected yield of about 1350 t when area quotas at the "sustainable" level were in effect.

10.2. Strait of Georgia

Yield options for shelf rockfish are not proposed for this region.

10.3. West Coast Vancouver Island

10.3.1. Silvergray rockfish--southern stock

10.3.1.1. Landing statistics/biological information

Canadian landings of silvergray rockfish in Area 3C continue to be low, although the last two years (1984: 108 t; 1985: 110 t) have been the highest on record (Table 10.3). No additional biological information has become available since the last review. Mean yield (1967-84) is 20 t from the Canadian portion.

10.3.1.2. Recommendation

The yield options are unchanged from 1985: a non-directed fishery (conservative); 100 t (sustainable); and 200 t (non-sustainable). The quota could be included as part of a combined shelf rockfish yield (Section 10.3.4). The sustainable option is determined as the top of range between the mean historical yield and the current peak yield. Yields in excess of 200 t should be considered in conjunction with U.S. management.

Table 10.3. Area 3C landings (t), effort (h), and LPUE (t/h) of silvergray rockfish 1967-85 from Canadian and U.S. portions.

Year	Nat.	Total landings[a]	Interviewed			Interviewed (25% qual.)		
			Landings[b]	Effort[c]	LPUE	Landings	Effort	LPUE
1967	CAN	0	0	0	-	0	0	-
	USA	48	47	3127	.02	-	-	-
1968	CAN	0	0	0	-	0	0	-
	USA	28	28	1547	.02	-	-	-
1969	CAN	0	0	0	-	0	0	-
	USA	6	6	1475	.00	-	-	-
1970	CAN	2	2	119	.02	1	1	1.00
	USA	21	19	1807	.01	-	-	-
1971	CAN	2	2	2	1.00	2	2	1.00
	USA	57	53	1184	.04	-	-	-
1972	CAN	0	0	0	.00	0	0	-
	USA	7	7	1278	.01	-	-	-
1973	CAN	0	0	0	-	0	0	-
	USA	1	1	1006	.00	-	-	-
1974	CAN	0	0	0	-	0	0	-
	USA	9	8	817	.01	-	-	-
1975	CAN	1	1	35	.03	0	0	-
	USA	38	38	904	.04	-	-	-
1976	CAN	5	5	9	.55	0	0	-
	USA	80	80	2395	.03	-	-	-
1977	CAN	18	18	476	.04	8	5	1.60
	USA	983	983	4390	.22	-	-	-
1978	CAN	1	1	48	.02	0	0	-
	USA	958	958	5319	.18	-	-	-
1979	CAN	1	1	22	.05	0	0	-
	USA	1005	1005	3606	.28	-	-	-
1980	CAN	3	3	20	.10	2	7	.29
	USA	384	384	2514	.15	-	-	-
1981	CAN	0	0	0	-	0	0	-
	USA	148	148	5024	.03	-	-	-
1982	CAN	3	3	224	.01	0	0	-
	USA	60	60	11819	.01	-	-	-
1983	CAN	84	84	156	.54	60	92	.65
1984	CAN	108	50	563	.09	19	67	.28
1985	CAN	110	65	296	.22	52	105	.49

[a]U.S. total landings equals Washington and Oregon combined.

[b]U.S. interviewed landings from Washington only (Tagart and Kimura 1982).

[c]U.S. interviewed effort represents total rockfish effort for Washington only (Tagart and Kimura 1982).

10.3.2. Yellowtail rockfish--southern stock

10.3.2.1. Landing statistics.

Yellowtail rockfish landings by Canadian vessels from Area 3C in 1984 and 1985 were very low (20 t) and 95 t, respectively (Table 10.4). The incidental catch in the hake fishery is unknown but thought to be comparable to the 1983 estimate of approximately 300 t (Doug Davenport, pers. comm.) No biological data were collected from the 1984 Canadian fishery.

United States scientists estimated an "acceptable biological catch" of 721-756 t for 1985, of which 20% (144-151 t) was thought to be available in Canadian waters of the INPFC Vancouver Area (Tagart 1984). This includes Areas 3A and 3B of the U.S. waters and Areas 3C and 3D in Canadian waters (all of the West Coast of Vancouver Island).

The U.S. estimates are much lower than their previous recommendations reflecting a greater reliance on a Stock Reduction Analysis (Kimura, et al. 1984), with lowered estimates on instantaneous natural mortality (M = 0.075). It also represents a reduced reliance on biomass survey results.

The geographic limits of the yellowtail stock are not known although tagging results indicate considerable mobility within the Vancouver Area (B. Leaman, pers. comm.). Virtually no biological information is available on the yellowtail fisheries within the Canadian portion of the area so the U.S. analysis represents the most reasonable means of integrating historical information. However, as the large yields in recent years (1980-83) have come almost entirely from U.S. waters, the Canadian stock, if there is not complete mixing, may be somewhat more abundant than predicted in the U.S. analysis. The 80:20 U.S.:Canadian split reflects the historical division of the catch.

10.3.2.2. Recommendations

Recommendations are slightly lowered from 1985. The by-catch in the hake fishery already may exceed the U.S. 1985 estimate of acceptable biological catch for the whole west coast of Vancouver Island. The three recommended options (conservative, sustainable, and non-sustainable) are: a non-directed, incidental fishery; 100 t and 200 t. The sustainable, 100-t option, in addition to the incidental catch of the hake fishery, probably also represents overfishing. It also takes into account the possibility that the Canadian portion of the stock may be in better condition than assumed in the U.S. analysis. Yield options in excess of 200 t should be considered in conjunction with U.S. management.

Table 10.4. Area 3C landings (t), effort (h), and LPUE (t/h) of yellowtail rockfish, 1967-85 from Canadian and U.S. portions.

Year	Nat.	Total landings[a]	Interviewed			Interviewed (25% qual.)		
			Landings[b]	Effort[c]	LPUE	Landings	Effort	LPUE
1967	CAN	1	1	22	.06	0	0	-
	USA	25	24	3127	.01	-	-	-
1968	CAN	0	0	0	-	0	0	-
	USA	188	187	1547	.12	-	-	-
1969	CAN	22	22	113	.19	16	55	.29
	USA	465	450	1475	.31	-	-	-
1970	CAN	10	10	360	.03	4	28	1.13
	USA	448	420	1807	.23	-	-	-
1971	CAN	10	10	100	.10	3	16	1.18
	USA	130	120	1184	.10	-	-	-
1972	CAN	11	11	437	.03	0	0	-
	USA	246	240	1278	.19	-	-	-
1973	CAN	20	20	246	.06	2	10	.18
	USA	186	176	1006	.17	-	-	-
1974	CAN	17	17	628	.03	0	0	-
	USA	34	34	817	.04	-	-	-
1975	CAN	6	6	216	.03	0	0	-
	USA	16	16	904	.02	-	-	-
1976	CAN	50	50	931	.05	16	91	.17
	USA	888	888	2395	.37	-	-	-
1977	CAN	237	237	1853	.13	189	83	2.29
	USA	710	710	4390	.16	-	-	-
1978	CAN	45	45	741	.06	18	56	.31
	USA	449	449	5319	.08	-	-	-
1979	CAN	40	40	668	.06	7	23	-.32
	USA	314	314	3606	.09	-	-	-
1980	CAN	37	37	477	.07	3	6	.51
	USA	620	620	2514	.25	-	-	-
1981	CAN	21	21	625	.03	6	17	-.35
	USA	2000	2000	5024	.40	-	-	-
1982	CAN	115	115	837	.14	94	63	1.50
	USA	1447	1447	11819	.12	-	-	-
1983	CAN	16	16	284	.06	10	6	1.48
1984	CAN	20	10	216	.05	7	10	.66
1985	CAN	95	26	405	.06	18	31	.57

[a]U.S. total landings equals Washington and Oregon combined.

[b]U.S. interviewed landings from Washington only (Tagart and Kimura 1982).

[c]U.S. interviewed effort represents total rockfish effort for Washington only (Tagart and Kimura 1982).

10.3.3. Canary rockfish--southern stock

10.3.3.1. Landing statistics/biological information

Catches in 1984 of canary rockfish by Canadian boats in Area 3C were the highest on record (307 t) while 1985 catches were 176 t (Table 10.5). No new biological data were collected in 1984. Length frequency samples were collected in 1976 (1) and 1983 (1). The earlier sample contained 100 specimens and indicated large fish. The more recent sample of 282 fish was composed of smaller fish which indicated natural mortality rates greater than 0.2 for males and greater than 0.3 for females. United States biologists (Golden and Demory 1984) recommended an Acceptable Biological Catch of 800 t for the U.S. portion of the INPFC Vancouver Area (north coast of Washington State).

10.3.3.2. Recommendations

The mean yield of canary rockfish from the Canadian portion of 3C is 90 t. The second type of catch history discussed in the Introduction (recent increase) suggests a yield of 200 t (midpoint of 90 and 303 t). While the 1983 sample implies overfishing, canary rockfish samples can show considerable variability in the same stock. I don't view the one sample as sufficient evidence for recommending a "sustainable" yield option of less than 200 t. However, since it is a sufficient source of concern I propose a non-sustainable level only 150% of the sustainable level. The three options are a non-directed fishery (incidental catch only), 200 t, and 300 t. Section 10.3.4 outlines a grouped quota for all shelf rockfish in this region.

10.3.4. Silvergray, yellowtail, canary rockfishes--grouped quota yield option for southern stocks.

10.3.4.1. Recommendations

The non-sustainable option is lowered for 1986. The yield options for combined shelf rockfish (silvergray, yellowtail and canary rockfish) in Area 3C are: non-directed (conservative), 300 t (sustainable), and 450 t (non-sustainable). Yields can be increased during the season should the catch by species be distributed roughly proportional to the individual species quotas.

Non-sustainable options are identified for yellowtail and canary rockfish for 1986. For 1985, these were omitted with the statement that any harvest in excess of sustainable levels should be discussed with U.S. managers. I am still of the same opinion but have included the options as guidelines.

Table 10.5. Area 3C landings (t), effort (h), and LPUE (t/h) of canary rockfish 1967-85.

Year	Nat.	Total landings[a]	Interviewed			Interviewed (25% qual.)		
			Landings[b]	Effort[c]	LPUE	Landings	Effort	LPUE
1967	CAN	0	0	0		0	0	-
	USA	226	223	3127	.07	-	-	-
1968	CAN	0	0	0	-	0	0	-
	USA	402	400	1547	.21	0	0	-
1969	CAN	0	0	0		0	0	-
	USA	154	149	1475	.10	-	-	-
1970	CAN	0	0	0	-	0	0	-
	USA	241	225	1807	.09	-	-	-
1971	CAN	51	51	454	.11	40	199	.20
	USA	471	437	1184	.29	-	-	-
1972	CAN	0	0	0		0	0	-
	USA	101	99	1278	.08	-	-	-
1973	CAN	0	0	0		0	0	-
	USA	50	47	1006	.05	-	-	-
1974	CAN	10	10	391	.02	1	6	.18
	USA	29	27	817	.04	-		
1975	CAN	7	7	178	.04	2	2	.90
	USA	205	205	904	.23	-	-	-
1976	CAN	55	55	655	.08	20	66	.30
	USA	208	208	2395	.09	-	-	-
1977	CAN	100	100	1684	.06	19	80	.24
	USA	136	136	4390	.03	-	-	-
1978	CAN	14	14	254	.06	2	9	.22
	USA	202	202	5319	.04	-	-	-
1979	CAN	22	22	477	.05	4	22	.18
	USA	64	64	3606	.02	-	-	-
1980	CAN	18	18	750	.02	9	72	.12
	USA	262	262	2514	.10	-	-	-
1981	CAN	13	13	663	.02	1	7	.14
	USA	188	188	5024	.04	-	-	-
1982	CAN	101	101	1138	.09	78	96	.81
	USA	133	133	11819	.01	-	-	-
1983	CAN	146	146	505	.29	140	214	.65
1984	CAN	307	254	889	.29	241	322	.75
1985	CAN	176	123	762	.16	111	172	.65

[a] U.S. total landings equals Washington and Oregon combined.

[b] U.S. interviewed landings from Washington only (Tagart and Kimura 1982).

[c] U.S. interviewed effort represents total rockfish effort from Washington only (Tagart and Kimura 1982).

10.3.5. Silvergray rockfish--northern stock

10.3.5.1. Landing statistics.

Silvergray landings were down 20% in 1984 (462 t) from 1983 (562 t) but rose to 811 t in 1985 to be the highest on record (Table 10.6).

No biological samples were collected in 1984. Non-qualified (0.26 t/h) and 25% qualified catch rates (0.37 t/h) declined in 1984 (Table 10.6) but results for 1985 (.30 t/h; .53 t/h) show catch rates higher than the two previous years. No trend is apparent but catch rates do not indicate a declining stock.

10.3.5.2. Recommendations

The catch history of Area 3D silvergray rockfish corresponds to the second type of catch history referred to in the Introduction (recent increase). Mean catch from 1967-82 equalled 213 t, since then Canadian trawlers have intensified their efforts and catches have more than doubled. The mid-point between historical mean catches and recent peak catch is 390 t. This is 40 t above the equilibrium option of 350 t for 1984. I recommend that the sustainable option remain at 350 t for 1986. The catch history only supports the contention that 213 t/year is sustainable. A doubling to 400 t seems excessive until we have an opportunity to examine the impact of recently increased yields. The 150 t conservative and non-sustainable option of 700 t are unchanged from 1984.

10.3.6. Yellowtail rockfish--northern stock

10.3.6.1. Landing statistics.

Only 19 t (Table 10.7) of yellowtail rockfish from the northwest coast of Vancouver Island were landed in 1984 although 1985 equalled 288 t. A sample taken from the 1985 catch indicates a mean length of 44.1 cm (males = 43.0, females = 45.2). Compared with the extensive time series of U.S. samples from Washington and Oregon, the mean size indicates a significantly exploited stock but not exploited to the extent of the U.S. fisheries, which are now perceived to have been overfished (Tagart 1984).

Average yield by North American trawlers (1967-1984) has been 104 t but including large catches by Polish trawlers in 1975 and 1976 (Westrheim 1980) it averages 574 t. If the stock is stationary within the area, the present size composition may still reflect the effect of the large catches of the 1975-76 harvests. If the Polish catch and LPUE data can be assumed to be accurate and reflect a real decline in abundance, then the two years of data can be used to calculate initial biomass by the DeLury method (Ricker 1975). The rate of decline in CPUE implies a starting biomass of approximatly 11,000 t and an after-harvest biomass of 2,300 t. Yields since the Polish fishery have averaged 89 t, so some rebuilding may have taken place, but probably has not led to a biomass greater than 3000 t unless extremely large year-classes

Table 10.6. Area 3D landings (t), effort (h), and LPUE (t/h) of silvergray rockfish, 1967-85.

Year	Nat.	Total Landings[a]	Interviewed			Interviewed (25% qual.)		
			Landings[b]	Effort[c]	LPUE	Landings	Effort	LPUE
1967	CAN	0	0	0	-	-	-	-
	USA	148	148	1344	.11	-	-	-
1968	CAN	0	0	0		-	-	-
	USA	177	172	1381	.12	-	-	-
1969	CAN	0	0	0	-	-	-	-
	USA	328	328	2172	.14	-	-	-
1970	CAN	0	0	0	-	-	-	-
	USA	350	339	2978	.11	-	-	-
1971	CAN	3	3	46	.07	-	-	-
	USA	154	154	1825	.08	-	-	-
1972	CAN	0	0	0	-	-	-	-
	USA	435	435	1691	.26	-	-	-
1973	CAN	0	0	0	-	-	-	-
	USA	226	226	1613	.14	-	-	-
1974	CAN	1	1	12	.08	-	-	-
	USA	227	227	1849	.12	-	-	-
1975	CAN	3	3	9	.33	-	-	-
	USA	75	75	2034	.04	-	-	-
1976	CAN	0	0	0	-	-	-	-
	USA	246	246	1550	.16	-	-	-
1977	CAN	10	10	40	.25	9	23	.39
	USA	52	52	1037	.05	-	-	-
1978	CAN	21	21	236	.09	1	8	.13
	USA	14	14	925	.02	-	-	-
1979	CAN	21	21	109	.19	13	18	.72
	USA	243	243	1206	.20	-	-	-
1980	CAN	20	20	194	.10	7	8	.88
	USA	380	380	1334	.28	-	-	-
1981	CAN	15	15	77	.19	9	24	.38
	USA	136	136	400	.34	-	-	-
1982	CAN	126	126	164	.77	124	126	.99
1983	CAN	562	562	1299	.30	330	745	.44
1984	CAN	462	285	1081	.26	218	591	.37
1985	CAN	811	284	946	.30	221	416	.53

[a]U.S. total landings equals Washington and Oregon combined.

[b]U.S. interviewed landings from Washington only (Tagart and Kimura 1982).

[c]U.S. interviewed effort represents total rockfish effort for Washington only (Tagart and Kimura 1982).

Table 10.7. Area 3D landings (t), effort (h), and LPUE (t/h) of yellowtail rockfish, 1967-85.

Year	Nat.	Total Landings[a]	Interviewed			Interviewed (25% qual.)		
			Landings[b]	Effort[c]	LPUE	Landings	Effort	LPUE
1967	CAN	2	2	4	.50	2	4	.50
	USA	80	80	1344	.06	-	-	-
1968	CAN	0	0	0	-	0	0	-
	USA	25	23	1381	.02	-	-	-
1969	CAN	1	1	27	.04	1	27	.04
	USA	104	99	2172	.05	-	-	-
1970	CAN	1	1	34	.03	1	5	.20
	USA	142	135	2978	.05	-	-	-
1971	CAN	5	5	62	.08	0	0	-
	USA	135	127	1825	.07	-	-	-
1972	CAN	0	0	0	-	0	0	-
	USA	72	72	1691	.04	-	-	-
1973	CAN	0	0	0	-	0	0	-
	USA	23	23	1613	.01	-	-	-
1974	CAN	0	0	0	-	0	0	-
	USA	109	109	1849	.06	-	-	-
1975	CAN	1	1	14	.07	0	0	-
	USA	73	73	2034	.04	-	-	-
1976	CAN	26	25	141	.18	15	43	.35
	USA	4	4	1550	.00	-	-	-
1977	CAN	8	8	50	.16	6	26	.23
	USA	174	174	1037	.17	-	-	-
1978	CAN	37	36	254	.14	15	16	.94
	USA	0	0	925	.00	-	-	-
1979	CAN	8	7	40	.18	3	8	.38
	USA	108	108	1206	.09	-	-	-
1980	CAN	18	18	91	.20	16	53	.30
	USA	45	45	1334	.03	-	-	-
1981	CAN	17	17	66	.26	17	44	.39
	USA	10	10	400	.02	-	-	-
1982	CAN	13	13	96	.13	7	18	.39
1983	CAN	36	31	274	.11	14	24	.58
1984	CAN	19	12	117	.10	6	22	.29
1985	CAN	288	261	603	.43	240	290	.83

[a]U.S. total landings equals Washington and Oregon combined.

[b]U.S. interviewed landings from Washington only (Tagart and Kimura 1982).

[c]U.S. interviewed effort represents total rockfish effort for Washington only (Tagart and Kimura 1982).

have entered the fishery. This is not apparent for recent landings or in the 1985 length sample. If the yellowtail rockfish of 3D are part of a larger stock from the INPFC Vancouver Area, as implied in the U.S. analyses, then any harvest from 3D would be further exceeding the U.S. biologists' estimates of an acceptable biological catch.

10.3.6.2. Recommendation

I recommend that the Area 3D yellowtail rockfish sustainable harvest be set at 150 t, 5% of the best available estimate of approximate biomass (<3000 t). The quota could be considered as part of a combined shelf rockfish quota. The conservative option is a non-directed (incidental) fishery and the non-sustainable option is 250 t.

10.3.7. Canary rockfish--northern stock

10.3.7.1. Landing statistics/biological information

Landings increased to 882 t in 1984 and 727 t in 1985 (Table 10.8). Qualified catch rate increased to 0.80 t/h in 1984, an increase from 0.54 in 1983 but lower than the 1982 level of 0.98. The 1985 results indicate a decline in qualified LPUE to 0.74. The LPUE estimates are without trend which tends to imply that overfishing is not occurring. However, given that Canadian fisheries have only just begun (1982-1985) to direct significant attention to this area it is surprising that their catch rates are not increasing through a learning response.

One biological sample was collected in 1985 from the Nootka fishery grounds. Males and females were slightly larger than in 1983 (Nootka) and 1984 (Esperanza) samples.

Age composition data was obtained from the 1983 Nootka sample. Log_e frequency analysis indicated "Z" values of 0.07-0.08 for males and 0.22 for females.

Neither the catch rates, length frequency, or 1983 age data provide clear evidence of overfishing. The truncated age spectrum for females is a source of concern but not unlike composition seen in stocks presumed to be unexploited (Archibald et al. 1981). There is not yet evidence that the 18-year mean yield of 485 t has led to overfishing.

10.3.7.2. Recommendation

I assume that the long-term yield of 485 t represents a minimum estimate of sustainable yield. The options discussed in the Introduction suggest increasing the estimated "sustainable" yield by a maximum of 30%. Because of the limited biological data available, and the failure of catch rates to increase as Canadian fishermen have learned to exploit the stock, we suggest raising the sustainable option by 15% to 550 t. Conservative and non-sustainable options are suggested to be 300 t and 800 t.

Table 10.8. Area 3D landings (t), effort (h), and LPUE (t/h) of canary rockfish 1967-85.

Year	Nat.	Total landings[a]	Interviewed			Interviewed (25% qual.)		
			Landings[b]	Effort[c]	LPUE	Landings	Effort	LUPE
1967	CAN	4	4	41	.10	1	8	.12
	USA	352	352	1344	.26	-	-	-
1968	CAN	19	19	157	.12	10	12	.83
	USA	536	502	1381	.36	-	-	-
1969	CAN	46	46	266	.17	42	127	.33
	USA	625	597	2172	.27	-	-	-
1970	CAN	18	18	96	.19	17	89	.19
	USA	749	713	2978	.24	-	-	-
1971	CAN	15	15	79	.19	12	36	.33
	USA	540	525	1825	.29	-	-	-
1972	CAN	0	0	0	-	0	0	-
	USA	193	193	1691	.11	-	-	-
1973	CAN	0	0	0	-	0	0	-
	USA	443	443	1613	.27	-	-	-
1974	CAN	16	16	70	.23	14	20	.70
	USA	578	578	1849	.31	-	-	-
1975	CAN	7	7	8	.88	7	8	.88
	USA	453	453	2034	.22	-	-	-
1976	CAN	138	138	167	.83	137	141	.97
	USA	187	187	1550	.12	-	-	-
1977	CAN	96	96	124	.77	90	67	1.34
	USA	222	222	1037	.21	-	-	-
1978	CAN	54	54	180	.30	38	47	.81
	USA	861	861	925	.93	-	-	-
1979	CAN	100	92	203	.45	90	153	.59
	USA	251	251	1206	.21	-	-	-
1980	CAN	108	108	308	.35	100	132	.76
	USA	215	215	1334	.16	-	-	-
1981	CAN	53	53	266	.20	41	77	.53
	USA	61	61	400	.15	-	-	-
1982	CAN	215	215	277	.78	208	213	.98
1983	CAN	707	501	1218	.41	453	835	.54
1984	CAN	882	693	1190	.58	675	848	.80
1985	CAN	727	488	1135	.43	446	607	.74

[a]U.S. total landings equals Washington and Oregon combined.

[b]U.S. interviewed landings from Washington only (Tagart and Kimura 1982).

[c]U.S. interviewed effort represents total rockfish effort for Washington only (Tagart and Kimura 1982).

10.3.8 Silvergray, yellowtail, canary rockfish--grouped quota for northern stocks.

10.3.8.1. Recommendation

The optimal species ratio within the 1000 t group quota for 1985 was 70:100 (412 t silvergray:588 t canary). Preliminary results for 1985 indicate a ratio of 112:100 (811 t silvergray:727 t canary). The proposed ratio for 1986 is again 70:100.

Proposed options for combined quotas of canary and silvergray rockfish are 400 t, 800 t, 1500 t.

Yellowtail rockfish were initially included in the combined quota but subsequently left unrestricted in order that fishermen could take advantage of a stock for which there is little information.

I recommend that the yellowtail quota be combined with other shelf species and be assumed to contribute a yield of 50 t. Yield options for shelf species would then be 400 t, 850 t, and 1600 t. Should yellowtail catches exceed 50 t, the quota could be allowed to increase to accommodate the extra catch to a maximum of an additional 100 t.

10.4. Queen Charlotte Sound

10.4.1. Silvergray rockfish

10.4.1.1. Landing statistics/biological information

Landings equalled 922 t in 1984 (Table 10.9), the fourth highest yield in the 18-year time series. In 1985, total landings equalled 905 t. Mean catch, including estimates of Japanese removals, equals 680 t.

No biological samples were collected in 1984 or 1985. No new ageing information is available. The qualified catch rate remained the same for 1984 and 1985. The limited data preclude an update on the 5A/B silvergray assessment.

10.4.1.2. Recommendation

There is no evidence that the long-term mean yield of 680 t has resulted in overfishing but the lack of data makes it difficult to look for the symptoms. Without the means to assess the stock, and because at 700 t/year this fishery is significant, I suggest that the increment be limited to 10% or 750 t. A conservative yield is 400 t and a non-sustainable option is 1100 t (150%).

Table 10.9. Area 5A and 5B landings (t), effort (h), and LPUE (t/h) of silvergray rockfish, 1967-85.

Year	Nat.	Total landings[a]	Interviewed			Interviewed (25% qual.)		
			Landings[b]	Effort[c]	LPUE	Landings	Effort	LPUE
1967	CAN	63	89	539	.17	63	200	.32
	USA	397	396	9,431	.04	-	-	-
1968	CAN	78	78	644	.12	37	109	.34
	USA	933	822	8,488	.10	-	-	-
1969	CAN	78	78	1188	.07	28	152	.18
	USA	1,291	1276	13,557	.09	-	-	-
1970	CAN	14	14	287	.05	6	29	.21
	USA	189	189	9,264	.02	-	-	-
1971	CAN	16	16	331	.05	6	66	.09
	USA	521	512	7,137	.07	-	-	-
1972	CAN	54	54	654	.08	21	108	.19
	USA	251	251	9,224	.03	-	-	-
1973	CAN	40	40	328	.12	33	70	.47
	USA	189	189	9,625	.02	-	-	-
1974	CAN	45	45	412	.11	9	12	.75
	USA	377	377	8,797	.04	-	-	-
1975	CAN	31	31	479	.06	19	61	.31
	USA	306	306	5,179	.06	-	-	-
1976	CAN	172	172	1,914	.09	82	224	.37
	USA	443	443	4,620	.10	-	-	-
1977	CAN	198	198	2,462	.08	123	320	.38
	USA	440	440	5,165	.09	-	-	-
1978	CAN	723	723	4,049	.18	468	1,069	.44
	USA	57	57	909	.06	-	-	-
1979	CAN	629	629	3,885	.16	429	1,225	.35
	USA	298	298	1,696	.18	-	-	-
1980	CAN	631	631	3,279	.19	495	1,538	.32
	USA	147	147	1,146	.13	-	-	-
1981	CAN	569	569	23,471	.24	462	860	.54
	USA	-	-	-	-	-	-	-
1982	CAN	756	735	4,558	.16	521	1,327	.39
1983	CAN	642	537	3,573	.15	365	1,100	.33
1984	CAN	922	678	3,402	.20	605	1,896	.32
1985	CAN	905	632	3,102	.72	536	1,540	.35

[a]U.S. total landings equals Washington and Oregon combined.

[b]U.S. interviewed landings from Washington only (Tagart and Kimura 1982).

[c]U.S. interviewed effort represents total rockfish effort for Washington only (Tagart and Kimura 1982).

10.4.2. Yellowtail rockfish

10.4.2.1. Landing statistics

Landings declined to 192 t in 1984 (Table 10.10), the lowest point in the 18 years of the detailed catch history of this stock. Landings increased to 330 t in 1985. One biological sample was collected in 1985. It reflected a higher proportion of small fish than previous samples. Catch rates are without trend but in recent years reflect such low catch and effort that the LPUE figures have little meaning.

10.4.2.2. Recommendation

Yield options are unchanged from 1985 at a conservative option of 500 t, a sustainable option of 1500 t and a non-sustainable level of 2500 t.

10.4.3. Canary rockfish

10.4.3.1. Landing statistics

Canary rockfish landings reached 498 t in 1984, (Table 10.11) the highest since 1976 and 369 t in 1985. Mean landings from 1967-84 equal 360 t. The qualified LPUE was 0.33 t/h in 1984, approximately equal to previous years. No biological samples were collected in 1984 or in 1985.

10.4.3.2. Recommendations

Following the first type of catch history referred to in the Introduction, the canary rockfish fishery appears stable at a relatively low yield. We recommend that sustainable yield be set at approximately 130% of the estimate of minimum sustained yield of 360 t. Recommended options are 250, 500, and 750 t. The non-sustainable level is lowered from 1985 recommendations because the lack of biological data makes it more difficult to pick up symptoms of overfishing.

10.4.4. Silvergray, canary rockfish--grouped quota

10.4.4.1. Landing statistics

From the recommended yield options the optimal ratio of silvergray to canary rockfish landings is 1.5. However the mean ratio over the last 6 years (1979-1984) is 2.28 which implies that setting the combined quota as the sum of the two individual quotas (750 + 500) would result in 125 tonnes too much coming from silvergray rockfish at the expense of the canary yield. A 1100 t yield would prevent overrunning the silvergray quota but reduce by 170 t the proposed canary yield.

The Pacific ocean perch/yellowmouth rockfish combined quota off the west coast of the Queen Charlotte Islands is optimized by taking advantage of seasonal effects on the relative abundance of the two species. The same opportunity is not apparent for this fishery. Table 10.12 shows the combined catches (1975-1985) by two month periods for the whole area as well as separately for Cape Scott and the Goose Island grounds. The ratio on the Goose Islands is the optimal ratio but it would require separate management by

ground. The only seasonal effect is the high catch of canary rockfish on the Goose Island grounds in the July/August period.

Management could take advantage of this effect but only by imposing trip quotas before and after the 2-month period.

10.4.4.2. Recommendations

I recommend that the two species remain as a combined quota to avoid discarding. If management wishes to avoid significantly exceeding the recommended sustainable yield for silvergrays, 1100 t is recommended. Conservative and non-sustainable options are 500 and 1700 t.

Table 10.10. Area 5A and 5B landings (t), effort (h), and LPUE (t/h) of yellowtail rockfish, 1967-85.

Year	Nat.	Total landings[a]	Interviewed			Interviewed (25% qual.)		
			Landings[b]	Effort[c]	LPUE	Landings	Effort	LUPE
1967	CAN	19	19	167	.11	16	24	.67
	USA	998	996	9,431	.11	-	-	-
1968	CAN	23	23	221	.10	18	70	.26
	USA	312	278	8,488	.03	-	-	-
1969	CAN	86	86	604	.14	60	101	.59
	USA	1,913	1,847	13,557	.14	-	-	-
1970	CAN	174	174	714	.24	149	278	.54
	USA	2,634	2,629	9,264	.28	-	-	-
1971	CAN	225	225	980	.23	212	710	.30
	USA	2,049	1,955	7,137	.27	-	-	-
1972	CAN	695	695	2,508	.28	581	1,105	.53
	USA	2,735	2,735	9,224	.30	-	-	-
1973	CAN	521	521	1,403	.37	496	952	.52
	USA	2,753	2,733	9,625	.29	-	-	-
1974	CAN	163	163	1,409	.12	104	284	.37
	USA	809	809	8,797	.09	-	-	-
1975	CAN	414	414	1,885	.22	356	883	.40
	USA	303	303	5,179	.06	-	-	-
1976	CAN	628	628	4,580	.14	429	1381	.31
	USA	363	363	4,620	.08	-	-	-
1977	CAN	1,013	1,011	4,738	.21	862	2,614	.33
	USA	1,242	1,242	5,165	.24	-	-	-
1978	CAN	1,646	1,646	5,050	.33	1,460	2,665	.55
	USA	397	397	909	.44	-	-	-
1979	CAN	1,334	1,321	3,815	.35	1,213	1,778	.68
	USA	192	192	1,696	.11	-	-	-
1980	CAN	471	471	2,631	.18	387	1,100	.35
	USA	81	81	1,146	.07	-	-	-
1981	CAN	285	285	2,281	.12	191	570	.34
1982	CAN	299	278	2,308	.12	197	703	.28
1983	CAN	323	262	1,711	.15	203	448	.45
1984	CAN	192	184	1,741	.11	124	469	.26
1985	CAN	330	292	1,600	.18	249	550	.45

[a]U.S. total landings equals Washington and Oregon combined.

[b]U.S. interviewed landings from Washington only (Tagart and Kimura 1982).

[c]U.S. interviewed effort represents total rockfish effort for Washington only (Tagart and Kimura 1982).

Table 10.11. Area 5A and 5B landings (t), effort (h), and LPUE (t/h) of canary rockfish, 1967-85.

Year	Nat.	Total landings[a]	Interviewed			Interviewed (25% qual.)		
			Landings[b]	Effort[c]	LPUE	Landings	Effort	LUPE
1967	CAN	41	41	535	.08	13	32	.41
	USA	216	215	9,431	.02			
1968	CAN	49	49	576	.09	31	78	.40
	USA	1,034	937	8,488	.11			
1969	CAN	67	67	733	.09	37	110	.34
	USA	464	418	13,557	.03			
1970	CAN	6	6	80	.08	4	12	.33
	USA	220	220	9,264	.02			
1971	CAN	18	18	329	.05	6	8	.75
	USA	207	183	7,137	.03			
1972	CAN	0	0	0	-	0	0	-
	USA	61	61	9,224	.01			
1973	CAN	29	29	119	.24	23	80	.29
	USA	298	298	9,625	.03			
1974	CAN	3	3	81	.04	1	7	.14
	USA	257	257	8,797	.03			
1975	CAN	23	23	403	.06	15	17	.88
	USA	189	189	5,179	.04			
1976	CAN	92	92	1,558	.06	16	49	.33
	USA	447	447	4,620	.10			
1977	CAN	121	121	2,356	.05	53	192	.28
	USA	288	288	5,165	.06			
1978	CAN	263	263	2,692	.10	101	242	.42
	USA	8	8	909	.01			
1979	CAN	308	308	3,070	.10	211	582	.36
	USA	62	62	1,696	.04			
1980	CAN	281	281	2,199	.13	198	451	.44
	USA	88	88	1,146	.08			
1981	CAN	185	185	1778	.10	86	206	.42
1982	CAN	359	331	3,223	.10	210	706	.30
1983	CAN	360	315	2,939	.11	163	466	.35
1984	CAN	498	312	2,474	.13	225	678	.33
1985	CAN	369	260	2,507	.10	154	529	.29

[a]U.S. total landings equals Washington and Oregon combined.

[b]U.S. interviewed landings from Washington only (Tagart and Kimura 1982).

[c]U.S. interviewed effort represents total rockfish effort for Washington only (Tagart and Kimura 1982).

Table 10.12. Analysis of the seasonal distribution of catches (t) of silvergray and canary rockfish in Queen Charlotte Sound (1975–1985).

	Jan/Feb	Mar/Apr	May/Jun	Jul/Aug	Sep/Oct	Nov/Dec	Totals	Ratio
5A & 5B								
Silvergray	510	1285	1275	1173	638	291	5172	2.08
Canary	284	383	459	1053	223	86	2488	
Goose Island								
Silvergray	204	687	816	628	187	45	2567	1.44
Canary	163	234	335	888	105	54	1779	
Cape Scott								
Silvergray	306	598	459	545	450	246	2604	3.67
Canary	121	150	124	166	117	32	710	

10.5. Hecate Strait

10.5.1. Silvergray rockfish

10.5.1.1. Landing statistics

Landings increased to 597 t in 1984 (Table 10.13) and to 1023 t in 1985. LPUE declined in 1984 but rose to 1.35 in 1985.

Two of the three biological samples collected from the 1985 fishery indicated a significant proportion of larger and presumably older fish. No recent material has been aged.

Mean yield over the history of the fishery is 240 t but as the fishery only became significant in 1976, it is more appropriate to calculate the yield starting from that year which produces a mean of 290 t. In the absence of any symptoms of overfishing, this can be considered to be a minimum estimate of sustainable yield. The same conclusions in 1982 led me to raise the recommended sustainable yield to 600 t for 1983 prior to catches ever exceeding 400 t (Table 10.14). The 600 t was then not reached until 1985. While the catch rates and persistence of large fish are encouraging signs, we suggest that the current 600 t ceiling (200% of the 9-year mean) remain for 2-3 more years to see how the stock responds to this level of yield. If there are still no signs of overfishing, the quota could be increased.

10.5.1.2. Recommendations

The recommended conservative and sustainable yields for silvergray in Areas 5C and 5D combined are unchanged at 300 and 600 t, the non-sustainable level is reduced to 900 t, 150% of the sustainable option.

10.5.2. Yellowtail, canary rockfish--grouped quota

10.5.2.1. Recommendation

Fisheries for canary and yellowtail rockfish in Areas 5C and 5D continue to be inconsequential. Recommendations are unchanged from 1985.

	5C			5D		
Yellowtail	100	200	400	150	350	500
Canary	150	250	500	n.d.	100	200
Combined	200	400	800	150	400	600

The species quotas could be combined for one area, or two area quotas could be combined for one species.

Table 10.13. Area 5C and 5D landings (t), effort (h), and LPUE (t/h) of silvergray rockfish, 1971-85.

Year	Nat.	Total landings	Interviewed			Interviewed (25% qual.)		
			Landings	Effort	LPUE	Landings	Effort	LPUE
1971	CAN	34	34	229	.15	24	121	.20
1972	CAN	61	61	232	.26	44	54	.81
1973	CAN	10	10	147	.07	-	-	-
1974	CAN	13	13	64	.20	11	34	.33
1975	CAN	11	11	191	.06	4	5	.79
1976	CAN	121	121	1,429	.08	55	414	.13
1977	CAN	234	234	2,059	.11	142	468	.30
1978	CAN	232	232	1392	.17	177	301	.59
1979	CAN	380	375	2,881	.13	189	473	.40
1980	CAN	337	337	1,886	.18	235	381	.62
1981	CAN	304	263	1,610	.16	221	258	.86
1982	CAN	121	100	1,339	.08	59	94	.63
1983	CAN	333	288	883	.33	247	310	.80
1984	CAN	597	332	1,050	.32	283	545	.52
1985	CAN	1,023	708	1,268	.56	577	429	1.35

Table 10.14. Area 5C and 5D landings (t) and recommended quotas for silvergray rockfish, 1979-85.

Year	Total landings	Recommended sustainable yield	Quota	Fishery closed when quota was reached
79	380	-		
80	337	300		
81	304	300		
82	121	400		
83	333	600[a]	300	no
84	540	600[a]	600	no
85	1023	600	600	yes

[a]Area 5C only.

10.6. West Coast of Queen Charlotte Islands

10.6.1. Yellowtail, canary and silvergray rockfishes--grouped quota

10.6.1.1. Landing statistics

Fisheries for shelf rockfish remain inconsequential in Area 5E.

Current landings of silvergray rockfish (Table 10.15) from 5E-N may represent overfishing of this stock, but no restrictions are proposed until the experimental period of open fishing for Pacific ocean perch is terminated.

10.6.1.2. Recommendations

Yield options are unchanged from those recommended for 1985. A suggested guideline sustainable yield for all 3 species is 200 t for 5E-N and 950 t for 5E-S. There is not sufficient information to suggest conservative or non-sustainable yield options.

Table 10.15. Area 5E-N and 5E-S landings (t), effort, and LPUE (t/h) of silvergray rockfish, 1977-85.

Year		Total landings	Interviewed			Interviewed (25% qual.)		
			Landings	Effort	LPUE	Landings	Effort	LPUE
1977	S	20	20	136	.15	0	0	-
	N	0	0	0	-	0	0	-
1978	S	124	124	572	.22	56	105	.53
	N	16	16	91	.18	16	21	.76
1979	S	44	44	189	.23	30	19	1.58
	N	8	8	95	.08	0	0	-
1980	S	104	104	246	.42	81	97	0.84
	N	15	15	17	.91	15	17	.91
1981	S	57	22	74	.30	12	12	1.00
	N	2	2	10	.20	0	0	-
1982	S	27	22	152	.14	7	4	1.75
	N	38	30	56	.54	27	9	3.00
1983	S	130	130	414	.31	44	58	.76
	N	16	11	108	.10	1	1	1.00
1984	S	78	71	246	.29	47	104	.45
	N	248	233	731	.32	61	33	1.88
1985	S	212	175	466	.38	85	142	.60
	N	245	245	1258	.20	158	219	.72

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